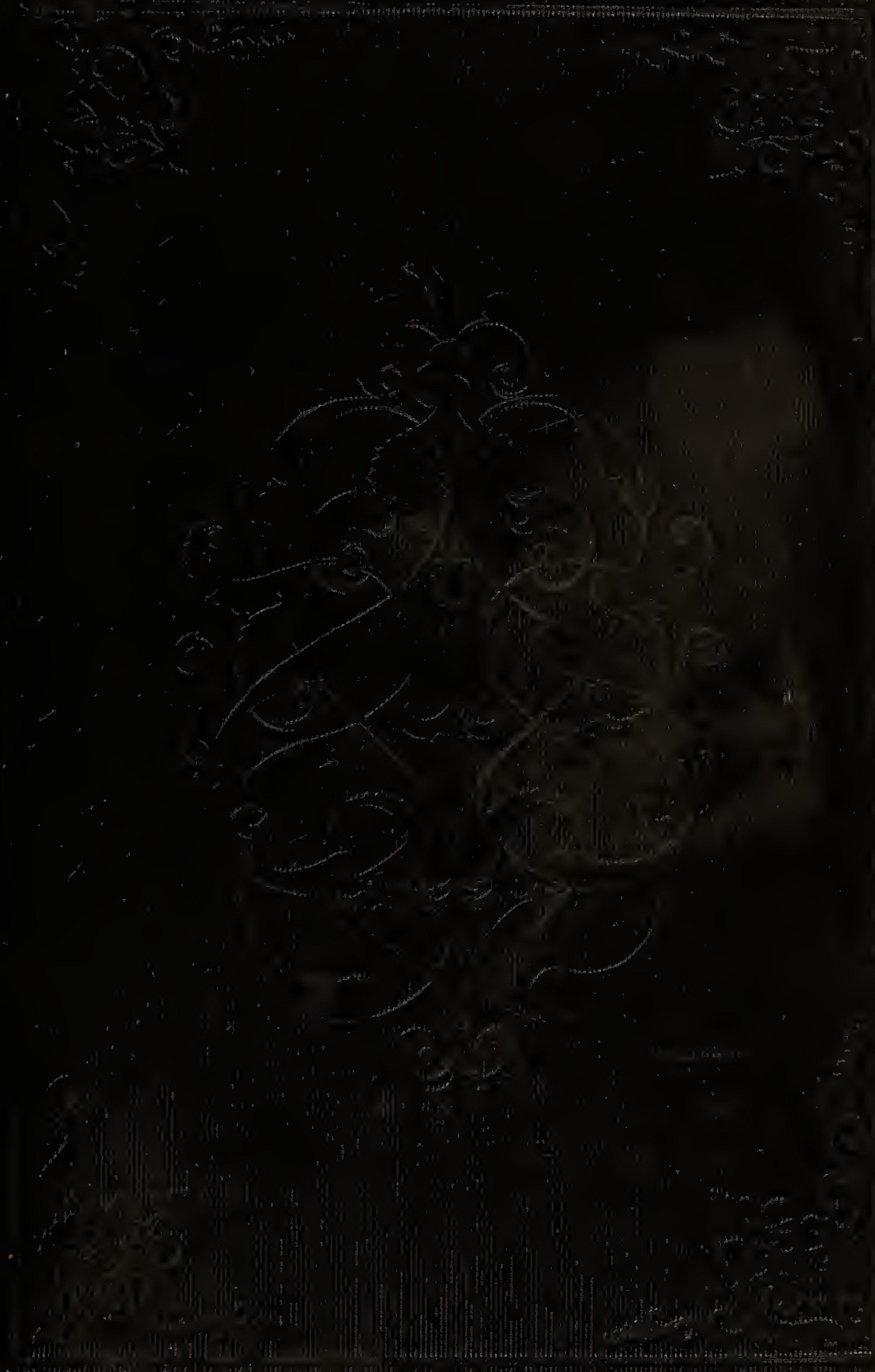

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KNIGHT'S
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DICTIONARY OF THE FARM,

BY

THE REV. W. L. RHAM,

VICAR OF WINKFIELD.

THE
DICTIONARY OF THE FARM.

BY

THE REV. W. L. RHAM,
VICAR OF WINKFIELD, BERKSHIRE.

SECOND EDITION.

WITH A SUPPLEMENT.

LONDON:
CHARLES KNIGHT AND CO., LUDGATE STREET.
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Note.—To complete the series of subjects in the 'Dictionary of the Farm,' the following articles have been added:—The Horse, Ox, and Sheep, by Mr. Youatt; Planting, by Dr. Lindley, F.L.S., &c. &c.; and the articles Potatoes and Poultry, by the Rev. Mr. Hickey,—the last two having been revised by Mr. Rham.

INTRODUCTORY NOTICE

OF THE

LIFE OF THE AUTHOR.

The lamented death of Mr. Rham, within less than a month after he had completed the materials of this volume for the press, cannot be passed over without a brief notice of his estimable and valuable life.

William Lewis Rham was born at Utrecht, in the Netherlands, in 1778; and of this country his father was, we believe, a native, but his mother was of Swiss birth. Mr. Rham came to England in early life. He studied for some time at Edinburgh, with a view to the medical profession, but eventually the church became his destination, and he entered at Trinity College, Cambridge. In 1806, being then in his twenty-eighth year, his name appears in the Tripos as tenth wrangler, the senior wrangler for that year being Sir Frederick Pollock, the present Chief Baron of the Exchequer. In 1808 Mr. Rham was presented by the Dean and Chapter of Salisbury to the living of Winkfield, Berkshire; and a few years afterwards the Nassau family presented him to that of Fersfield, in Norfolk. He died unmarried at Winkfield, after a short illness, on the 31st of October, 1843.

The life of Mr. Rham was uneventful, but it was marked by active and unremitting usefulness as a parochial clergyman. He was the friend of the poor in the best sense of the term. He looked beyond the wants of the moment, and sought the means to improve and elevate as well as temporarily to benefit the objects of his benevolence. At the Winkfield School of Industry, which, under his fostering care, became a model for all similar institutions in country parishes, the young were taught not only the elements of knowledge, but were instructed in useful arts, and trained to habits of industry. Such were the means by which he endeavoured to promote the best interests of his parishioners. He was much beloved by all classes amongst them, and they are about to erect a tablet to his memory in the parish church.

The school which Mr. Rham founded at Winkfield is thus described by Mr. Tremenheere, in his Report to the Council of Education in March, 1843:—"This school was established in 1835 for 50 boys and 50 girls. The building consists of a house for the master and mistress, two schoolrooms, a workshop, shed, &c. It is surrounded by two acres of garden, to which two more acres have been lately added, to be also cultivated, by the master and the boys, with the various agricultural crops, according to the most approved method and rotations. The industrial work originally projected for the boys was—gardening, the use of carpenters' and joiners' tools, basket and mat making; for the girls, the usual needle-work, washing, ironing, cooking, and the common household employments, under the direction of the mistress. The manual instruction of the boys in the workshop has been hitherto of a limited kind;

but the garden presented very satisfactory evidences of their skill and industry. It is cultivated in common, with the exception of small plots about twelve feet square, which belong to the boys, and of the produce of which they keep a debtor and creditor account. The produce of the rest is sold to persons who take it off to market, and the proceeds are carried to the general account of the establishment. The crops were abundant, and more varied than it is usual to see in common gardens. Something was found to fill up every space, and to suit every spot — either one of the ordinary garden crops, or some of the useful herbs, or some kind of plant or flower; and thus a lesson of considerable use to a cottager is early communicated, in the habit of making the most of even the smallest portion of ground, however apparently unpromising. The practical instruction, and the valuable example, of which the pupils here have the benefit in their garden-work, will be greatly extended when the agricultural operations commence in the field just added to the establishment. They will then enjoy the further advantage of pursuing all the details of the most skilful husbandry, under the same good guidance, namely that of the benevolent originator of this institution, the Rev. W. L. Rham, so well known as an accomplished agriculturist. The school will, indeed, from that period be able to offer to the children of the agricultural labourer a course of practical training in garden and farm management of no ordinary excellence."

But it is as a scientific agriculturist that Mr. Rham's name is most widely known; and, until recently, it was perhaps better known in other countries than in England. His early connection with the Continent, which was kept up in after-life, afforded scope for observation of the husbandry of different countries; and his thorough knowledge of several living languages gave him access to the works of scientific writers on foreign agriculture. In the next place, his chemical studies at Edinburgh, while preparing for the medical profession, were of eminent service to him; and scarcely less so was the proficiency in mathematics which he attained at Cambridge. It may safely be asserted that no other writer on agriculture ever enjoyed in so great a degree such a combination of advantages; and to his knowledge of the chemical and mechanical departments of agriculture there was united a thorough acquaintance with its routine details. We would simply refer to the article 'PLOUGH,' as an example of this combination of science with practical knowledge. On his farm at Winkfield he engaged in his favourite pursuit, with a practical perception of its details, and a scientific knowledge of its processes, which has probably never before been possessed by one person. Thus, above all other writers of the present day on the subject of agriculture, Mr. Rham was eminently fitted, by his excellent judgment and sound sense, to be useful to the country in the existing state of its husbandry and rural economy, when, probably, we are on the eve of great improvements in every department of these most important branches of industry. He was an active member of the council and upon the committees of the Royal Society of Agriculture, from its formation in 1838: his loss at this moment is therefore great. The present volume contains his views on all the principal subjects of interest to the agriculturist. It is compiled, without alteration, from the articles which he wrote in the 'Penny Cyclopædia,' the first article [AFTER-MATH] being contributed by him in 1833, and the last [YORKSHIRE AGRICULTURE] in 1843, only a few weeks before his lamented death. He was also the author of 'Flemish Husbandry,' a small work written for the 'Farmers' Series of the Library of Useful Knowledge.' This work was founded on a pedestrian tour in Flanders, in which, for many weeks, he walked from farm to farm, enjoying the rough hospitality of an industrious population, speaking their language readily, and entering into their pursuits with the zeal of a skilful and sympathizing friend. The Essay on the Analysis of Soils, for which he obtained the prize offered by the Royal Society of Agriculture, is published in the Society's 'Journal,' which also contains some other valuable contributions from his pen. Not long before his death he had also commenced a series of papers on agriculture and rural economy in the 'Gardeners' Chronicle,' edited by his friend Dr. Lindley.

Mr. Rham's correspondence on agricultural subjects, both in this country and on the Continent, was extensive; and he gave his opinion with the utmost readiness. Nor did he stop here, or remain content with having acquitted himself with extreme urbanity and courtesy, but not unfrequently pressed his hospitality upon those who had consulted him. Great as was the respect paid to his opinions, he gave them without the least dogmatism. In one of his last communications to a valued friend,* there is a passage at once characteristic of his unassuming disposition and of his deference to humble practical experience, which men who have acquired a scientific knowledge of any art are usually too apt to despise. "Whatever," he remarks, "great chemists may say about the component parts of soils, I am persuaded they can never decide as to the aptitude of any soil to produce a crop till experience has shown it. I believe we have all overlooked some electro-magnetic qualities which we have not yet instruments to measure." It was this reliance upon experience, in connection with a bold but searching investigation of theory, which renders Mr. Rham's writings so well adapted for the present time. In the eagerness for improvement, a writer is best calculated ultimately to benefit his country who unites scientific attainments of a high character with a rational degree of respect for the practice of ages.

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* Joshua Rodwell, Esq. of Alderton Hall, Suffolk.

DICTIONARY OF THE FARM.

AFTERMATH is the grass which grows after the hay has been made; it is also called *latter-math*, *rowen*, or *rowett*, and when left long on the ground it is called *fogg* in some places. Where the land is rich and hay valuable, the aftermath is often mown and made into hay. This hay is inferior in value and nourishment to the first crop, which contains the flower-stalks of the grass. It is not good for horses, especially those which are driven fast and work hard; it is thought injurious to their wind. Cows and sheep are fond of it, and with them it is not liable to the same objection. Whether it be more profitable to cut a second crop of hay, or to feed off the aftermath, must depend on circumstances and situations. Unless the meadows can be irrigated, or well manured, taking off two crops of hay in one year exhausts them, and is apt to produce moss, which the tread of sheep and cattle prevents.

There is a practice with some farmers to leave the aftermath on the ground from hay-making time to the next spring; this is then called *fogg;* and the young grass springing up through the old, makes it palatable to young cattle. Arthur Young mentions this practice with some commendation, as a resource in spring; but it does not accord with a well-regulated system of husbandry, in which all food should, if possible, be given in its most perfect state. The fogg, half rotten by a wet winter, cannot be wholesome food; besides, slugs and various insects breed in it. The aftermath should be fed off clean before winter. A good farmer should have hay, straw, and roots sufficient for his stock. Swedish turnips, mangel-wurzel, carrots, &c. can be stored in winter and strewed upon the pastures in spring, by which the stock will be better fed, and the land improved.

ARABLE LAND, so called from the Latin word *arare*, " to plough," is that part of the land which is chiefly cultivated by means of the plough.

Land in general is divided into arable, grass land, wood land, common pasture, and waste. The first of these is by far the most important in agriculture. In this article we shall briefly explain the principles on which are founded the most improved methods of cultivating arable land, by which the natural produce of the soil is greatly increased, and many productions are obtained in perfection which are foreign to the soil and climate.

1. We shall consider the nature and properties of various soils.

2. The best modes of preparing and improving the natural soil, so as to increase its produce.

3. The most advantageous succession of crops, so as to obtain the greatest returns, with the least diminution of fertility.

1. Soils.—When the surface of the earth is penetrated, we generally find that the appearance, texture, and colour vary at different depths. There is a layer of earth nearest the surface, of greater or less thickness, which covers the more solid and uniform materials which lie below it. This may be particularly observed wherever there are natural or artificial excavations or pits. A distinct line, nearly parallel to the surface, generally marks the depth of the upper soil, and separates it from the subsoil. The soil is more or less composed of

minute parts of various kinds of earth, mixed with animal and vegetable substances, in different states of decomposition; and to these, in a great measure, it owes its colour, which is generally darker than that of the subsoil. Except where iron, peat, coal, or slate abound in the soil, a dark colour is an indication of corresponding fertility. The rich soil of gardens, long cultivated and highly manured, is nearly black. As the soil is the bed in which all vegetable productions are to be reared, and in which they are to find their proper nourishment, its texture and composition become objects of great importance to the cultivator; and, without a competent knowledge of these, no practical rules can be laid down or depended upon.

All soils are composed of earths,* metallic oxides, saline substances, vegetable and animal matter, and water. The earths are chiefly clay or alumina, flint or silica, and lime.

Magnesia, barytes, and other earths are occasionally met with, but in so few instances that they may be omitted in the list.

Of the metals, the most abundant is iron in the state of peroxide. The other metals are rarely found near the surface.

Saline substances form a small part of a soil, but an important one.

Potassa exists in almost every vegetable, soda in a few, and ammonia is produced by the decomposition of animal matter, but from its volatile nature it is not long retained in the soil, except when it forms a fixed compound with other substances.

The vegetable acids, as a general rule, are perhaps limited to small portions of acetic acid in combination with some base, as lime or potash.

The mineral acids are found united with earths and alkalies, in the state of neutral compounds.

These saline substances have a powerful effect on vegetation, and a knowledge of their proportions in the soil, and of their various qualities, is indispensable in order to modify or correct their action by other substances for which they have an affinity.

Water, in a state of combination, or of mere mechanical diffusion, is essential to the growth of all plants: without it, and atmospheric air, there is no life either animal or vegetable.

The Earths.—Clay is called alumina because it is obtained in its purest state from alum, in which it is combined with the sulphuric acid:* it is the basis of all strong and heavy soils. When clay is minutely divided, it is easily suspended in water; when dried slowly, and stirred while drying, it becomes a fine powder soft to the feel, and when kneaded with water, a tough ductile mass easily moulded into hollow vessels, which retain liquids. This property, of being impervious to water, gives the specific character to clay as an ingredient of the soil. In a pure and unmixed state it is absolutely barren. When clay is heated to a great degree, it parts with the water combined with it; it is then said to be baked, as we see in bricks. It is no longer diffusible in water, and differs little from silica or sand in its effects on the soil.

Silica, or the earth of flints, suffers no change in water. It consists of crystals, or fragments, of very hard stone, forming gravel or sand according to their size; and the finest siliceous sand, when examined with a magnifying glass, has the appearance of irregular fragments of stone without any cohesion between them.

Siliceous sand holds water in its interstices by simple cohesive attraction in proportion to its fineness. It heats and cools rapidly, letting the water pass through it readily, either by filtration or evaporation. Its use in the soil is to keep it open, to let the air and water, as well as those other substances on which the growth of plants depends, circulate through it. Unmixed, it dries so rapidly that no vegetation can continue in it, unless a constant supply of moisture be given by irrigation. A small addition of clay much improves light sands; it takes a large quantity of sand to correct the tenacity of clay.

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* We retain the old division, although the earths have been ascertained to be oxides of peculiar metals, but as they are never found in the soils in their metallic state, the results and reasonings are not affected by this circumstance.

* Sulphuric acid, commonly called oil of vitriol, is composed of one equivalent of sulphur with three equivalents of oxygen.

Lime in its pure state is familiar to every one as the basis of the mortar used in building. It is produced by burning marble, chalk, limestone, or shells, with a great heat. In the stones which are formed principally of lime it is combined with some acid, most generally carbonic acid, which separates from it by the operation of burning, in the form of an air or gas, hence called *fixed air*, from its being thus *fixed* in a stone. These stones, of various degrees of hardness, are now all classed under the name of carbonates of lime.

Lime unites readily with water, which it also absorbs from the atmosphere. It then becomes *slaked*. By uniting with carbonic acid, it returns to its former state of carbonate; with this difference, that, unless much water be present, it remains a fine impalpable powder. Pure lime is soluble in water, though sparingly; a pint of water cannot dissolve more than about twenty grains: the carbonate is not soluble in water. Carbonate of lime has a powerful effect on the fertility of a soil, and no soil is very productive without it. It is consequently used extensively as an improver of the soil, otherwise called a manure; but its use in this respect, and the mode in which it acts, will be given in the articles MANURE and LIME.

Carbonate of lime, as an earth, is neither so tenacious as clay nor so loose as sand. In proportion to the fineness of its particles, it approaches to the one or the other, and when the parts are large and hard it takes the name of limestone gravel.

Its distinguishing feature is its solubility in acids, which it neutralizes, depriving them of their noxious qualities in the soil. A proper mixture of these three earths, in a due state of mechanical division, forms a soil well fitted to the growth of every species of plants, especially those which are cultivated for food; and nothing more is required than a proper climate as to heat, a proper degree of moisture, and sufficient nourishment, to make all the plants generally cultivated thrive most luxuriantly in such a mixture, which is usually called a loam.

But there are some soils which, besides a proper mechanical texture and mixture of earths, contain a large proportion of a natural manure which renders them extremely fertile. This is a substance produced by the slow decay of animal and vegetable matter. It can be separated from the other parts of the soil, and has been accurately analyzed and described by many of the most experienced chemists, particularly by Fourcroy, Davy, Chaptal, and Theodore de Saussure. (See *Recherches Chimiques sur la Végétation*, Paris, 1804, 8vo.) This substance has been called *vegetable mould;* but, as this is not a very distinct term, we shall, after Thaer and other eminent writers on agriculture, adopt the name of *humus* when speaking of it. Humus is a dark, unctuous, friable substance, nearly uniform in its appearance. It is a compound of oxygen, hydrogen, carbon, and nitrogen, which, with the exception of nitrogen, which is found only in some substances, are the elements of all animal and vegetable substances. It is the result of the slow decomposition of organic matter in the earth, and is found in the greatest abundance in rich garden mould or old neglected dunghills. It varies somewhat in its qualities and composition, according to the substances from which it has been formed and the circumstances attending their decay. It is the product of organic power such as cannot be compounded chemically.

Besides the four essential elements in its composition, it also contains other substances in smaller quantities, viz., phosphoric and sulphuric acids combined with some base, and also earths and salts. Humus is the product of living matter and the source of it. It affords food to organization. Without it nothing material can have life. The greater the number of living creatures, the more humus is formed; and the more humus, the greater the supply of nourishment and life. Every organic being in life adds to itself the raw materials of nature, and forms humus, which increases as men, animals, and plants increase in any portion of the earth. It is diminished by the process of vegetation, and wasted by being carried into the ocean by the waters, or it is carried into the atmosphere by the agency of the oxygen of the air, which converts it into gaseous matter. (See Thaer, *Grundsätze der Rationellen Landwirthshaft*, Berlin, 1810, four vols. 4to.)

Humus, in the state in which it is usually found in the earth, is not soluble in water, and we might have some difficulty in comprehending how it enters into the minute vessels of the roots of plants; but here the admirable provision of nature may be observed. Humus is insoluble and antiseptic; it resists further decomposition in itself, and in other substances in contact with it. It remains for a long time in the earth unimpaired; but no sooner is it brought into contact with the atmosphere, by the process of cultivation, than an action begins. Part of its carbon uniting with the oxygen of the atmosphere, produces carbonic acid, which the green parts of plants readily absorb; while its hydrogen with the same forms water, without which plants cannot live; and in very warm climates, where this process goes on more rapidly, the moisture thus produced keeps up vegetable life, when rains and dews fail. The residue becomes a *soluble extract*, and in that state is taken up readily by the fibres of the roots. But the changes still go on; the extract absorbs more oxygen, and becomes once more insoluble, in the form of a film, which Fourcroy calls *vegetable albumen*, and which contains a small portion of nitrogen, readily accounted for. By bringing fresh portions of humus to the surface and permitting the access of air to it, more carbonic acid, water, extract, and albumen are formed, and give a regular supply to the plants, which, by their living powers, produce the various substances found in the vegetable kingdom of nature. Hence we see the great importance of frequently stirring the surface of the earth between cabbages and other vegetables.

It is to the patience and perseverance of the chemists above named that we owe this insight into the wonderful process of vegetable growth. What we here state is on their authority.

We can now readily understand the great importance of humus, and of those rich manures which are readily converted into it, when not immediately absorbed by plants. But it has still another property, highly important to fertility: it renders stiff clays porous, and consolidates loose sands. It does so more than lime or any other earth. Hence a soil with a considerable portion of humus is much more fertile than the quantity of alumina, or of sand, in its composition would lead one to expect, as we shall see when we come to the analysis of soils of known fertility; and we see the great advantage of animal and vegetable manures, not only as nourishment to vegetables, but as mechanical improvers of the texture of soils.

The greatest enemy of humus is stagnant water; it renders it acid and astringent, as we see in peat; and soils abounding with vegetable matters, from which water is not properly drained, become *sour*, as is very justly said, and produce only rushes and other useless and unpalatable plants. The remedy is simple and obvious;—drain well, and neutralize the acid with lime; by these means abundant fertility will be restored.

In very light soils humus is seldom found in any quantity, being too much exposed to the air, and rapidly decomposed; the extract is washed through them by the waters, and as they waste manure rapidly, they are called *hungry*. Such soils are very unprofitable, until they are improved and consolidated by clay or marl, which makes them retain the moisture.

With calcareous earths humus acts well, provided they are pulverized and of sufficient depth. Some chalky soils are rendered very fertile by judicious culture and manuring.

In order to ascertain the probable fertility of a soil, it is very useful to analyze it, and find out the proportion of its component parts. To do this with great accuracy requires the knowledge of an experienced chemist; but, to a certain degree, it may be easily done by any person possessed of an accurate balance and weights, and a little *spirits of salts*, or muriatic acid. For this purpose, some of the soil, taken at different depths, not too near the surface (from four to eight inches, if the soil is uniform in appearance), is dried in the sun till it pulverizes in the hand, and feels quite dry: the small stones and roots are taken out, but not minute fibres. A convenient portion of this is accurately weighed: it is then heated in a porcelain cup, over a lamp or clear fire, and stirred till a chip or straw put in it turns brown. It is then set to cool, and weighed; the loss of weight is the water, which it is of importance to notice. Some soils, to appearance quite dry, contain a large proportion of water, others scarcely any. It is then pulverized and sifted, which separates the fibres and coarser parts. The remainder, again weighed, is stirred in four or five times its weight of pure water; after standing a few minutes to settle, the water is poured off, and it contains most of the humus and soluble substances. The humus is obtained by filtration, well dried over the lamp, and weighed. The soluble substances are obtained by evaporating the water; but, unless there is a decidedly saline taste, this may be neglected. The humus may be further examined by heating it red hot in a crucible, and stirring it with a piece of the stem of a tobacco-pipe, when the vegetable part will be consumed, and the earths remain behind; thus the exact quantity of pure vegetable humus is found. Some muriatic acid, diluted with five times its weight of water, is added to the deposit left after pouring off the water containing the humus and soluble matter; the whole is agitated, and more acid added gradually, as long as effervescence takes place, and until the mixture remains decidedly acid, which indicates that all the calcareous earth is dissolved. Should there be a great proportion of this, the whole may be boiled, adding muriatic acid gradually, till all effervescence ceases; what remains, after washing it well, is siliceous and argillaceous earth. These are separated by agitation, allowing the siliceous part to settle, which it does in a few seconds. The alumina is poured off with the water, filtrated, heated over the lamp, and weighed: the same with the siliceous sand. The loss of weight is calcareous earth. In this manner, but with greater care and more accurate tests, various soils of known fertility have been analyzed, of which we will give a few examples.

A very rich soil near Drayton, Middlesex, examined by Davy, consisted of ⅗ of siliceous sand and ⅖ of impalpable powder, which, analyzed, was found to be composed of

	Parts.
Carbonate of lime	28
Siliceous earth	32
Alumina	29
Animal and vegetable matter .	11
	100

This is a rich sandy loam, probably long and highly manured, fit for any kind of produce, and, if deep, admirably fitted for fruit trees.

Another good turnip soil, by the same, consisted of 8 parts of coarse siliceous sand and 1 of fine earth, which, being analyzed, consisted of

	Parts.
Carbonate of lime	63
Silica	15
Alumina	11
Oxide of iron	3
Vegetable and saline matter .	5
Water	3
	100

This is a very light sandy soil, and owes its fertility to the fine division of the carbonate of lime and the vegetable and saline matter. It may probably have been limed or marled at some time or other.

The best loam in France, according to Mr. Tillet, consists of

	Parts.
Fine siliceous sand	21
Coarse ditto	25
Carbonate of lime . . .	37·5
Alumina	16·5
	100

A loam at Chamart, highly prized by gardeners about Paris as the basis of their artificial soils, consists of

	Parts.
Argillaceous sand	57
Finely divided clay	33
Siliceous sand	7·4
Carbonate of lime, coarse .	1
Ditto, fine	·6
Woody fibre	·5
Humus and soluble matter .	·5
	100

The argillaceous sand is composed of fragments of soft stone, which retain moisture, and do not bind hard; the small proportion of humus is of no consequence where manure is to be had in any quantity.

A very rich heath or bog earth found at Meudon, and in great request for flowers and in composts, consists of

	Parts.
Gritty siliceous sand	62
Vegetable fibres partly decomposed	20
Humus	16
Carbonate of lime	·8
Soluble matter	1·2
	100

This soil, like our bog earth, would be very unfit for the growth of corn; but, from the quantity of humus and vegetable matter, is highly useful in composts and artificial soils; mixed with lime, it would make an excellent top-dressing for moist clay soils.

Mr. Thaer has given a classification of soils of known qualities, which we think worthy of notice. It is as follows:—

No.		Clay, per cent.	Sand, per cent.	Carb. of Lime, per cent.	Humus, per cent.	Value.
1	First class of strong wheat soils	74	10	4½	11½	100
2		81	6	4	8⅖	98
3		79	10	4	6½	96
4		40	22	36	4	90
5	Rich light sand in natural grass	14	49	10	27	?
6	Rich barley land . . .	20	67	3	10	78
7	Good wheat land	58	36	2	4	77
8	Wheat land	56	30	12	2	75
9	Ditto	60	38	Very insignificant quantities.	2	70
10	Ditto	48	50		2	65
11	Ditto	68	30		2	60
12	Good barley land	38	60		2	60
13	Ditto, second quality . . .	33	65		2	50
14	Ditto	28	70		2	40
15	Oat land	23½	75		1½	30
16	Ditto	18½	80		1½	20

Below this are very poor rye-lands.

In all these soils the depth is supposed the same, and the quality uniform to the depth of at least six inches; the subsoil sound, and neither too wet nor too dry.

Nos. 1, 2, and 3 are alluvial soils, and, from the division and the intimate union of the humus, are not so heavy and stiff as the quantity of clay would indicate.

No. 4 is a rich clay loam, such as is found in many parts of England, neither too heavy nor too loose—a soil easily kept in heart by judicious cultivation.

No. 5 is very light and rich, and best adapted for gardens and orchards, but not for corn; hence its comparative value can scarcely be given.

Nos. 6, 7, 8, are good soils; the quantity of carbonate of lime in No. 8 compensates for the smaller portion of humus. This land requires manure, as well as the others below. In those from No. 9, downwards, lime or marl would be the greatest improvement. Nos. 15 and 16 are poor light soils, requiring clay and much manure; but even these lands will repay the cost of judicious cultivation, and rise in value.

The last column, of comparative value, is the result of several years' careful valuation of the returns, after labour and seed had been deducted.

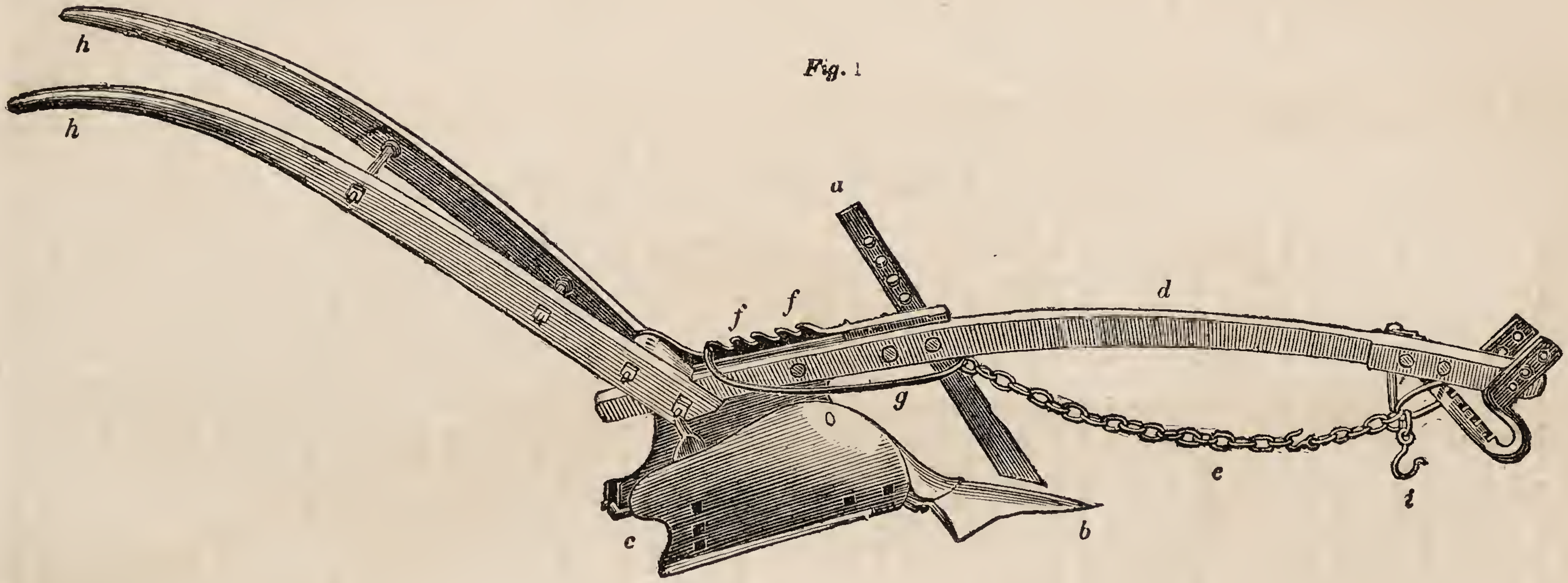
Few soils in England contain more than 4 or 5 per cent. of humus, even when in very good heart; and 2 per cent., with a good loamy texture, will render a soil fit for corn with judicious cultivation. The texture is of most importance, as may be seen by comparing Nos. 7 and 8 with No. 6. If this is of good quality, dung will soon give the proper supply of humus.

The depth of the soil and the nature of the subsoil greatly affect its value. However rich it may be, if there is only a thin layer of good soil over a sharp gravel or a wet clay, it can never be very productive: in the first case, it will be parched in dry weather; and in the latter, converted into mud by every continued rain. If the subsoil be loam or chalk, six inches of good soil will be sufficient. With a foot of good soil, the subsoil is of little consequence, provided it be dry, and the water can find a ready outlet. The best alluvial soils are generally deep, the chalky shallow.

The exposure, with respect to the sun, and the declivity of the ground, are very important circumstances, and equivalent to an actual difference in the climate. A gentle declivity towards the south, and a shelter against cold winds, may make as great a difference as several degrees of latitude; and in comparing the value of similar lands in different climates, the average heat and moisture in each must be accurately known. A soil very fertile in the south of Europe may be very unproductive in England; and a light soil of some value in the west of Scotland might be absolutely barren in Italy or Spain.

2. Cultivation of the Soil.—The better the soil, the less cultivation it requires to produce tolerable crops; hence, where the land is very rich, we find in general a slovenly culture; where the ground is less productive, more labour and skill are applied to compensate for the want of natural fertility. The simplest cultivation is that of the spade, the hoe, and the rake—and on a small scale it is the best; but spade husbandry cannot be carried to a great extent without employing more hands than can be spared from other occupations. The plough, drawn by oxen or horses, is the chief instrument of tillage, and has been so in all ages and nations of which we have any records. Its general form is familiar to every one, and requires no minute description. The various kinds of ploughs in use at different times, and the improvements which have been made, and are attempted daily, will be noticed in a separate article [see Plough]. Suffice it to say, at present, that a plough should as much as possible imitate the work done with a spade. It should cut a slice from the land by its coulter (*Figs.* 1, 2, *a*) vertically, and by the share (*b*) horizontally lift it up, and turn it quite over by means of the mould-board (*c*); and the art of the ploughman consists in doing this perfectly, and with such a depth and width as suit the soil and the intended purpose. In rich mellow soils a ploughed field should differ little from a garden dug with a spade. In tenacious soils, the slice will be continued without breaking, especially if bound by the fibres and roots of plants: the whole surface will be turned over, and the roots exposed to the air: it is of great consequence that each slice be of the same width and thickness, and the sides of it perfectly straight and parallel. The plane of the coulter must be perfectly vertical, and that of the share horizontal, in order that the bottom of the furrow may be level, without hollows or *baulks*, which are irregularities produced by the rising or sinking of the plough, or inclining it to either side. The ancients were very particular in this respect, and recommended sounding the earth with a sharp stake, to ascertain whether the ploughman had done his duty. There are various modes of ploughing land, either quite flat, or in *lands* or stitches, as they are called in England, and, in Scotland, *riggs*, that is, in portions of greater or less width, with a double furrow between them—somewhat like beds in a garden. Sometimes two ridges are set up against each other, which is called ridging or *bouting;* the land then is entirely laid in high ridges and deep furrows, by which it is more exposed to the influence of the atmosphere and kept drier; this is generally done before winter, especially in stiff wet soils. Sometimes two or more ridges are made on each side, forming narrow stitches. When the ground is to be ploughed without being laid in lands or stitches, and all the ridges inclined one way, the mould-board of the plough is shifted at each turn from one side to the other. The plough which admits of this is called a *turn-wrest plough,* and is in general use in Kent, and in many parts of the Continent, where the subsoil is dry and the land not too moist. In most other situations the ground is laid in *lands,* and the mould-board of the

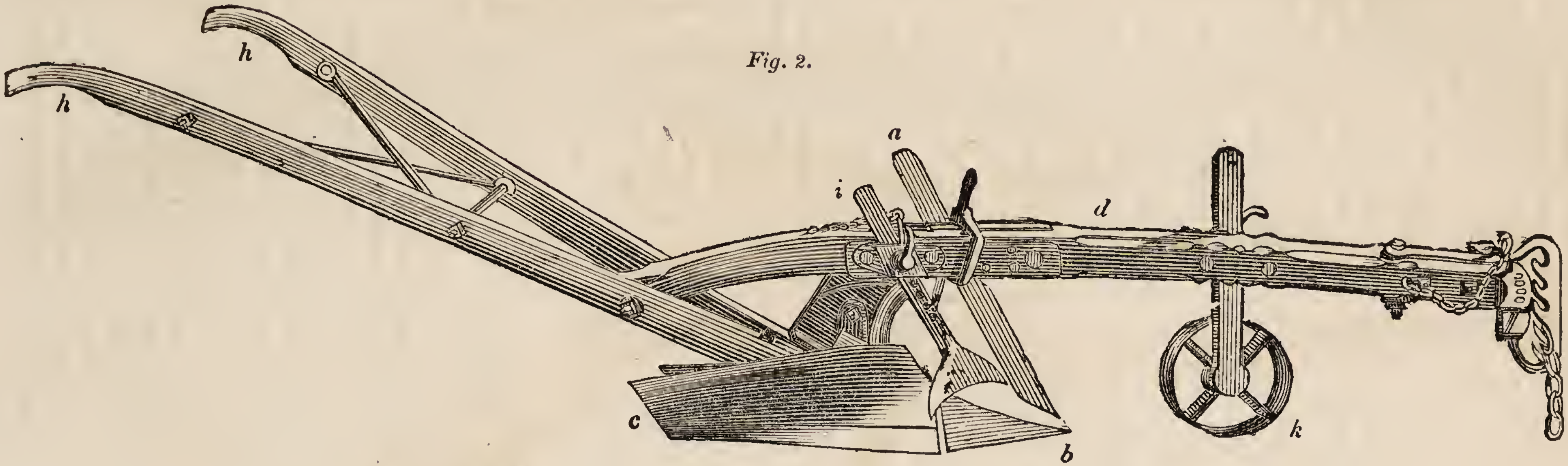
Fig. 1



[Plenty's Swing-Plough.]

a, The coulter. *b*, The point of the share. *c*, The mould-board. *d*, The beam.
e, The chain by which it is drawn; *g*, a long iron link to which the chain is fixed, which can be hooked in any of the notches *f f*, altering the line of draught.
h h, The handles, or stilts. **i, The hook to draw by.**

Fig. 2.



[Plenty's Improved Flemish **Plough**, with one wheel and skim-coulter.]

This plough differs from the common swing-plough, in having a small wheel (*k*) by which the depth of the furrow is more easily regulated,—and a skim-coulter (*i*), which pares off the grass and weeds, and turns them into the bottom of the furrow; it is also broader at the point. It is suited to light friable soils.

plough is fixed on the right side. When grass land or stubble is ploughed, care must be taken to bury the grass and weeds completely, and the slice cut off by the plough must be turned over entirely, which is best done by making the width of the furrow greater than the depth. When the grass and weeds are rotten, and the ground is ploughed to pulverize it, a narrow deep furrow is best; the earth ploughed up is laid against the side of the preceding ridge, which forms a small furrow between the tops of the ridges, well adapted for the seed to lodge in and to be readily covered with the harrows. (*Fig.* 3.)

Nothing has divided both practical and theoretical agriculturists more than the question whether the land should be ploughed deep or shallow; but a very slight attention to the purposes for which land is ploughed, and to the nature of the soil, will readily reconcile these apparently contradictory opinions. A deep, rich, and stiff soil can never be moved too much nor too deep: deep ploughing brings up rich earth, admits the air and water readily, and gives room for the roots to shoot, whilst the rich compact soil affords moisture and nourishment. Wherever trees are to be planted, the ground should be stirred as deep as possible, even in a poor soil: for grass and corn, this is not always prudent; their roots seldom go above three or four inches deep, and if they find sufficient moisture and humus, they require little more depth.

Whenever the soil below a certain depth is of an inferior quality, there can be no use in bringing it up; and where the soil is light and porous, the bottom had much better not be broken. Norfolk farmers know this well, and are very careful not to break the *pan*, as they call it, in their light lands: this *pan* is formed by the pressure of the sole of the plough and the tread of the horses, and opposes a useful bank to the too rapid filtration of the water: it lies from five to eight inches below the surface. If it is broken, the manure is washed down into the light subsoil, and the crop suffers, especially when sheep have been folded, their dung being very soluble. In such soils an artificial pan may be formed by the *land-presser* or *press-drill.* (*Fig.* 4.) This instrument consists of two very heavy cast-iron wheels, *a a*, with angular edges, set on an axle, at a distance from each other equal to the width of the furrows, and a lighter wheel, *b*, to keep the instrument vertical.

It is drawn by a horse immediately after the plough, pressing two furrows at once, and going twice over each furrow. It leaves the land in regular drills, and the seed sown by hand falls into the bottom of the drills, and is covered by the harrows. When the plants come up, they appear in regular parallel rows.

The great object in ploughing land is to divide it, expose every part of it to the influence of the elements, and destroy every plant or weed but those which are sown in it. To do this perfectly requires several ploughings, with certain intervals, and during that time no crop can be upon the land. This is the real use of fallows, and not, as was once supposed, to allow the land to rest; on the contrary, it ought then to have the least repose.

Where the soil is good, with a porous subsoil, the greatest care should be taken not to go too deep; but where the subsoil is compact and impervious to water, but not wet for want of outlet or draining, it is useful to stir the soil to a great depth, but without bringing it to the surface, which may be done by a plough without a mould-board following a common plough in the same furrow. This is an excellent mode of draining, and at the same time keeping a reservoir of moisture, which in dry weather ascends in vapours through the soil and refreshes the roots.

The mode in which the soil is prepared most perfectly for the reception of the seed is best shown by following the usual operations on fallows:—After the harvest, the plough is set to work, and the stubble ploughed in. The winter's frost and snow mellow it, while the stubble and weeds rot below. In spring, as soon as the weather permits, it is ploughed again, the first ridges being turned over as they were before: this completes the decomposition of the roots and weeds. It is then stirred with harrows or other instruments, which tear up the roots which remained, and some of these, not being easily destroyed, are carefully gathered and burnt, or put

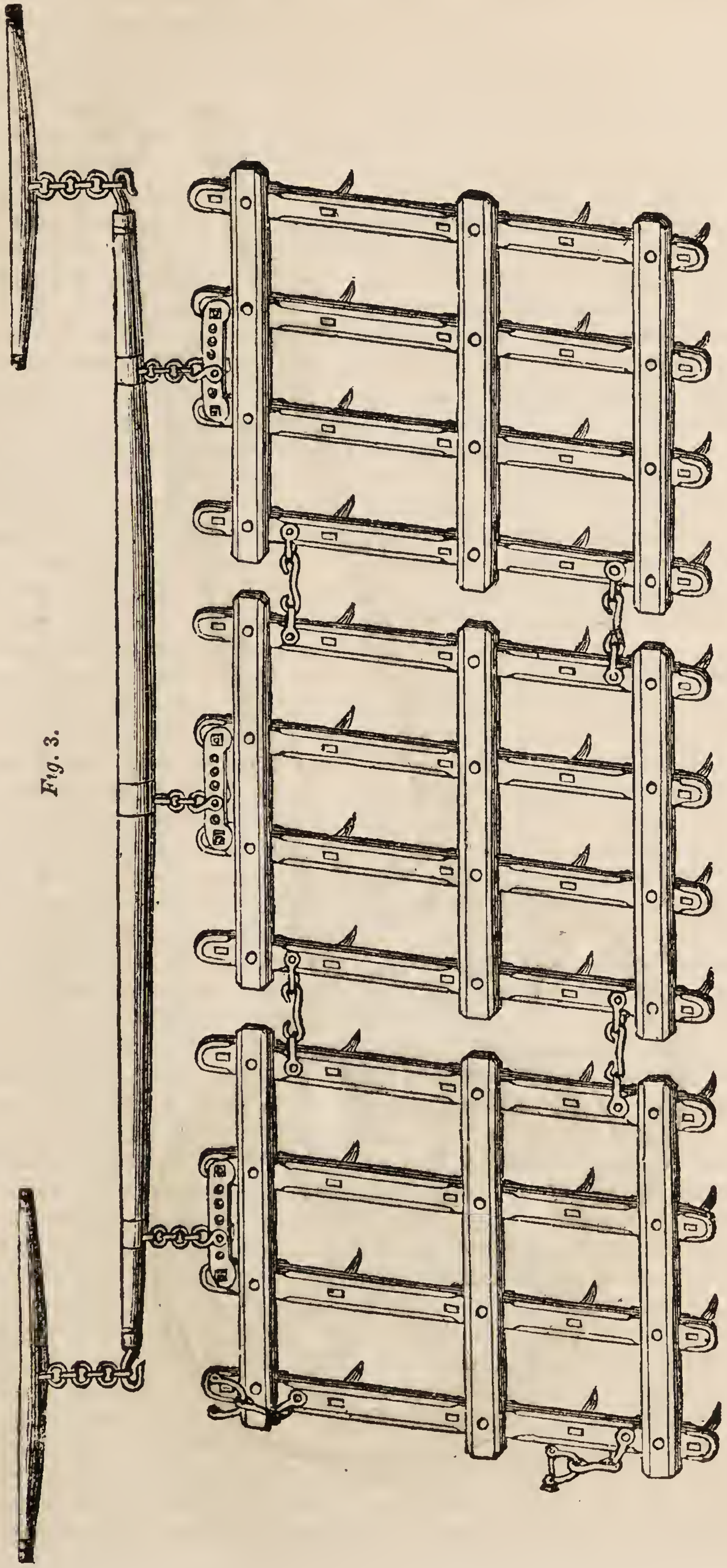
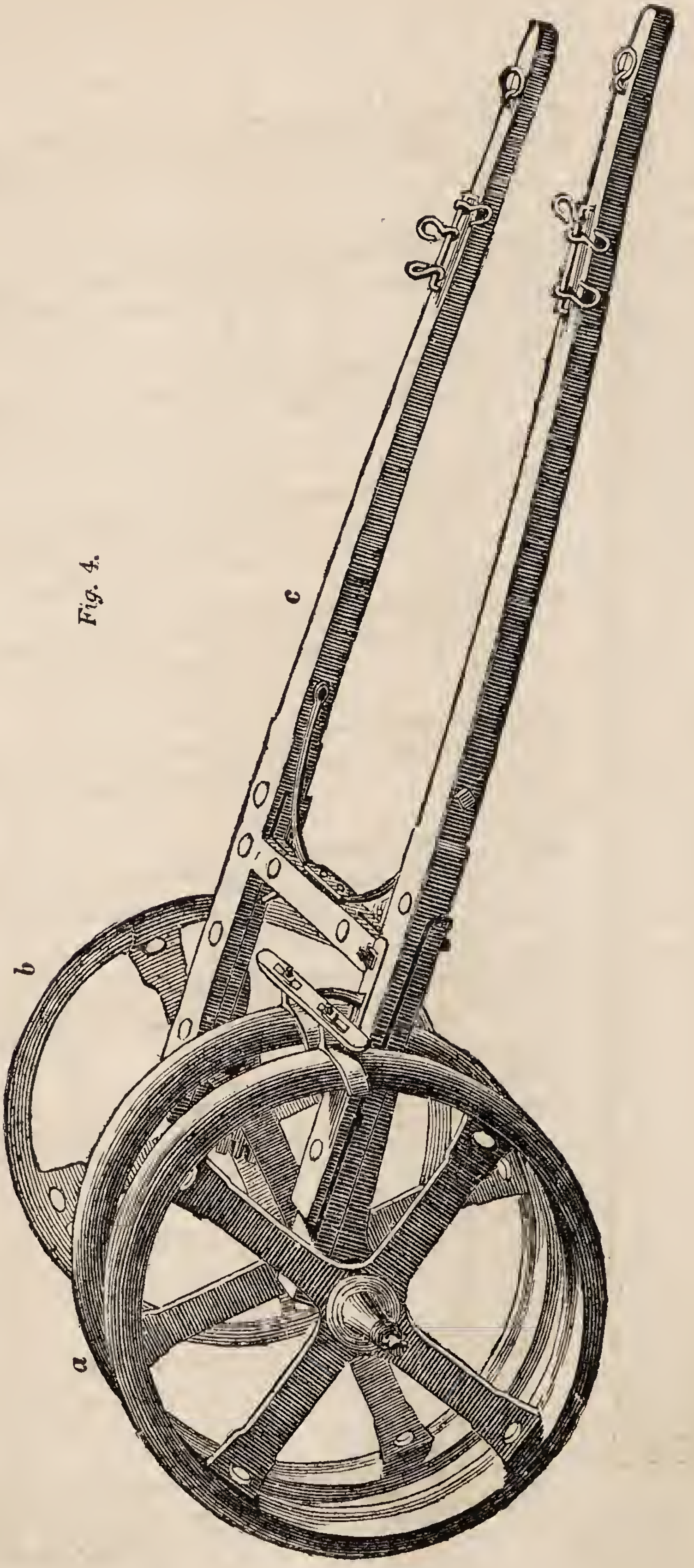


Fig. 3.

[Plenty's Common Rhomboidal Harrow.]

Fig. 4.



[Plenty's Press-Drill or Land-Presser.]

in a heap to ferment and rot, a portion of quick lime being added. Another ploughing and stirring follows, at some interval, till the whole ground is mellow, pulverized, and free from weeds; manure is put on, if required, and immediately spread and ploughed in: the land is then prepared for the seed.

This has been the method universally followed by all industrious husbandmen from the oldest times. The Romans had names for each of the ploughings: the first was *fringere,* the next *vertere,* the third *refringere,* and the fourth *revertere;* more ploughings were often given, and in modern agriculture the direction of the third ploughing is sometimes changed across the old furrows, at a right or acute angle, as Virgil recommends (*Georgica,* i. 98), by which the earth is still better divided and mixed.

Various instruments have been invented to stir the earth and mix it, without so often using the plough, and also to loosen and separate roots and weeds; of these the principal are, the cultivator or scarifier (*Fig.* 5), which enters but a few inches into the ground, and moves a great surface by means of tines, or iron teeth of various constructions. The whole instrument is made of iron: *a a* is the frame; *b*, the beam; *c*, rods by which it is drawn, the horses being attached by a hook at the point *d*; *e e*, the handles; *f f f*, different shaped shares and tines to be used according to the state of the soil; *g g g*, contrivances by which the teeth are fixed to the frame at any required distance from each other, and lengthened or shortened; *h h h*, three wheels to regulate the depth of the ground moved. By raising the beam and fixing it higher or lower on the piece (*i*), by means of an iron pin passed through the different holes, the whole instrument is raised or depressed in the ground.

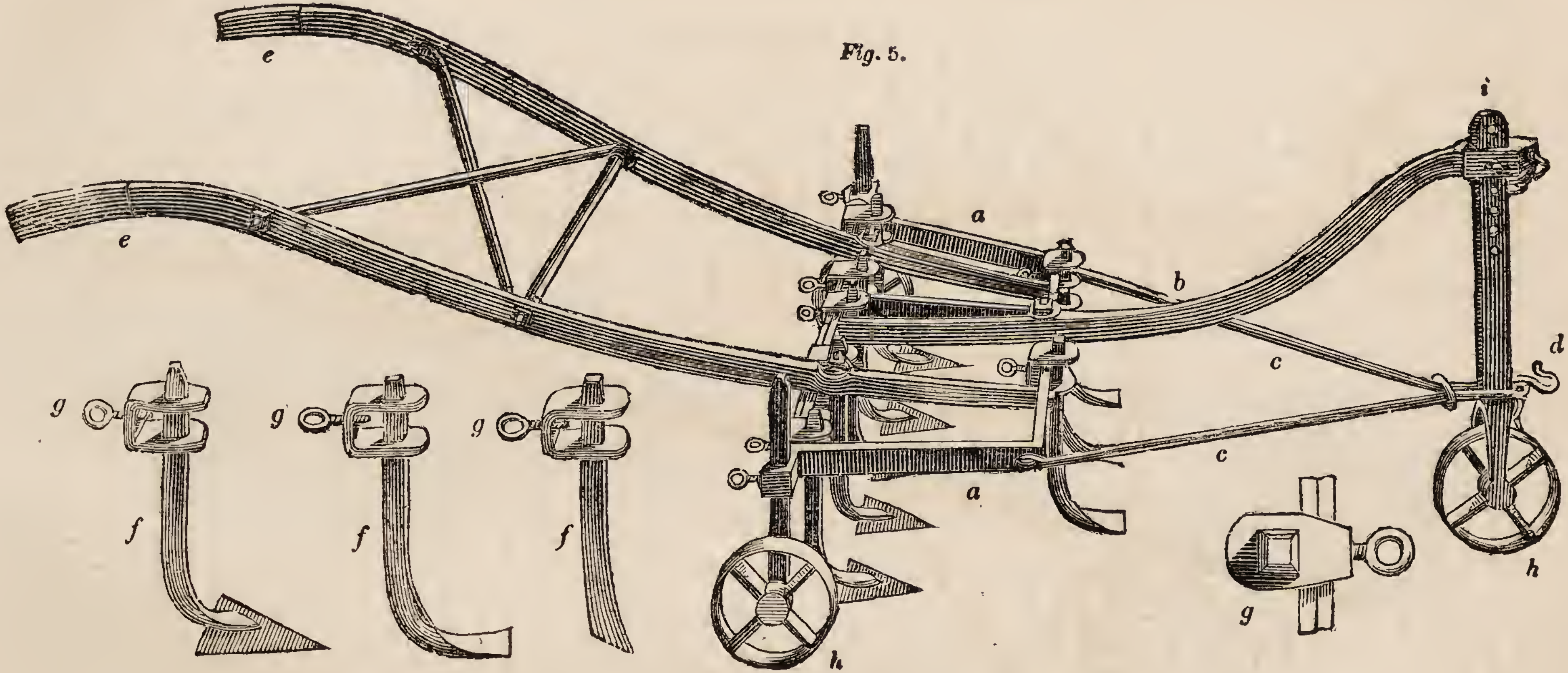
This instrument divides the soil, but does not turn it over; it is well calculated to destroy roots and weeds, and let in the air; but, evidently, is only adapted to tolerably loose and mellow soils, where there are no large stones.

An ingenious harrow or cultivator has been invented by Finlayson (*Fig.* 6), which rakes the weeds out of the ground, and throws them on the surface without clogging the instrument; it is excellent in light soils.

When the soil turned up by the plough is in large hard lumps, a roller, sometimes with spikes in it, is drawn over the land to break the clods, or mallets are used to break them by hand; but this is seldom necessary except where very stiff soils have been ploughed when too wet, and the ridges have dried, and been ploughed again in dry weather. Deep wet clay soils should be carefully watched, to know when is the proper time to plough them: nothing pulverizes them like frost, and if they are kept from wet by careful draining and numerous water-furrows in autumn, they will be loose and friable in spring; they had better not be touched than worked when too wet. On light soils the plain roller (*Fig.* 7) is used to advantage to produce firmness, without which the plough cannot so well turn the ground over completely, but merely pushes it to the right and left.

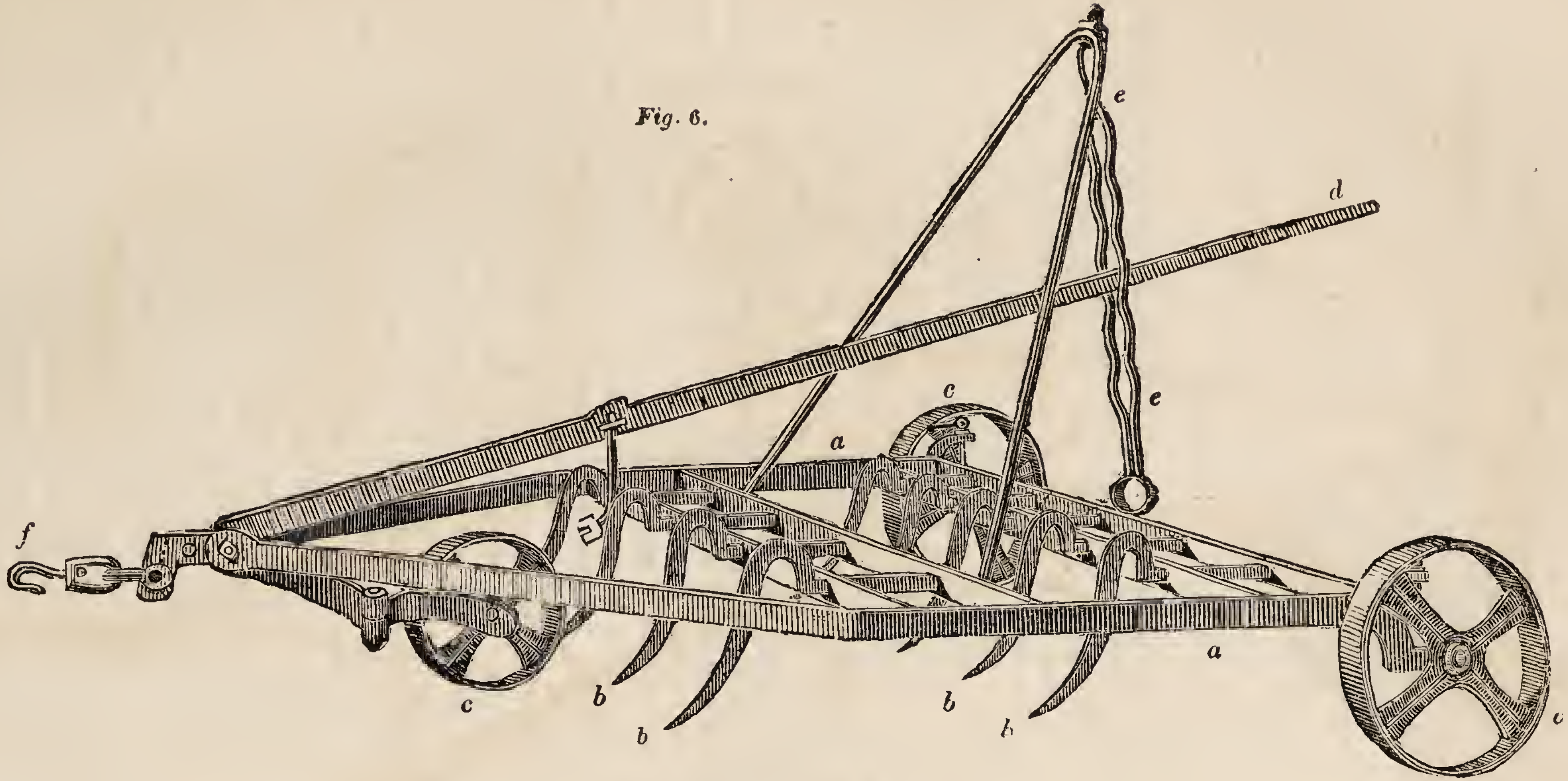
The great expense of teams for the plough has led to expedients and inventions to lessen the labour, but, in general, a more imperfect cultivation has resulted from it. Columella mentions one Celsus, whom he blames, because, to "save the expense of a stronger team, he only scratched the ground with small shares and toothed instruments (*exiguis vomeribus et dentalibus*);" and a modern agriculturist of some note has revived the practice of Celsus. General Beatson, who had been in India, and had seen the simple instruments used there by the natives, has substituted for the plough and cultivators in common use, various light instruments, of which he has published an account. He recommends stirring the soil only a few inches deep, except occasionally; and, by means of burnt clay, which he uses in great abundance, he has produced a succession of good crops: but he has too high an opinion of the fertilizing qualities of burnt clay, which makes him undervalue animal and vegetable manure; and although he may improve the texture of his heavy soil by the burnt clay, which is insoluble and absorbent, he will soon find out, like the followers of Tull, that manures which contain soluble extract, or from which it can be formed, can alone maintain fertility.

Fig. 5.



[Plenty's Scarifier.]

Fig. 6.



[Finlayson's Patent Harrow.]

a a, The iron frame. *b b*, The teeth, shaped so as to throw the weeds over.

c c c, Three small wheels, of which the foremost is brought forward by depressing the lever *d*, and raising the teeth out of the ground.

e e is a contrivance to keep the lever *d* in any required position, so as to regulate the depth to which the teeth, *b b*, enter the ground.

f is the hook by which the instrument is drawn.

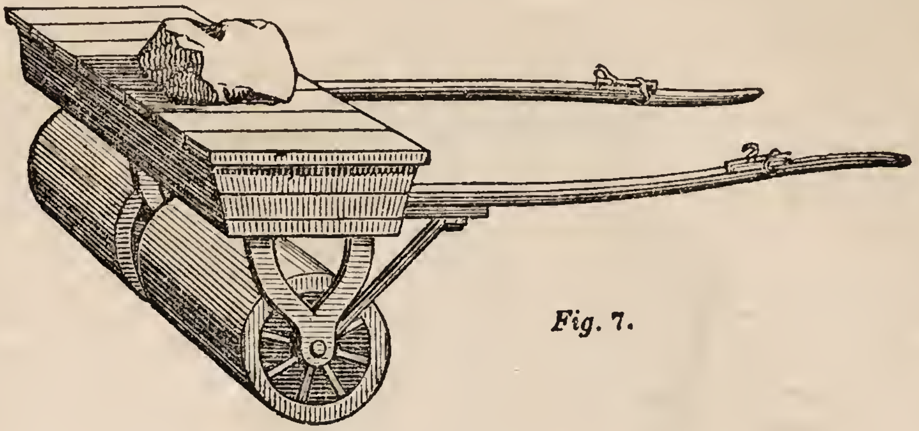


Fig. 7.

[Roller.]

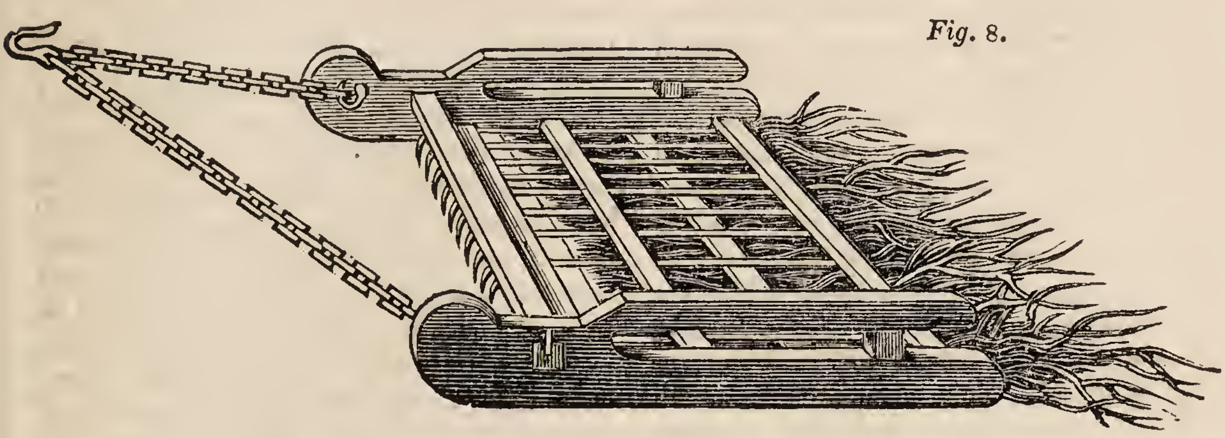
The influence of the atmosphere on the soil, and the increased fertility produced by pulverizing and stirring heavy lands, has led to the notion adopted by Jethro Tull, that labour might entirely supersede the necessity of manure: hence the origin of the horse-hoeing husbandry, which at one time was so highly thought of as to be called, by way of distinction, the *new* husbandry. Fallows and manuring were both discarded as unnecessary; the seed was sown in rows, with wide intervals, which were continually kept worked and stirred. At first the result was highly satisfactory; all the humus, by exposure to the air, was converted into soluble extract, and taken up by the plants, which throve well as long as the supply lasted: but in the end it was exhausted; and the warmest admirers and supporters of Tull's system, Du Hamel and De Châteauvieux, besides many others, found to their cost, in practice, that pulverizing alone will not restore fertility. The system of drilling and horse-hoeing, when united with judicious manuring, has, however, been found a great improvement in agriculture.

In describing the various processes in general use in the cultivation of the soil, we have taken the year when the land is fallowed, because it is then that it receives the most perfect culture, which enables it to produce several crops afterwards with a much smaller quantity of labour. By such fallowing and proper manuring, the soil is fully restored to its highest degree of fertility. In light soils, which are generally poorer, turnips or other green crops are sown, on which sheep are folded. The sheep, by their manure, still more enrich the soil, and it is only when this manure is ploughed in, that the land may be considered as possessing the proper degree of fertility.

There are some soils which are so mixed with pebbles and stones, that the foregoing observations will scarcely be applicable, and the instruments must be adapted to their texture. Some of these soils, abounding with chalk, are tolerably fertile, and the stones, when they are not so large as to impede the operations, are rather beneficial than otherwise. Theophrastus mentions a field which had been deprived of its fertility by the removal of the stones, and others have learned the same from experience. Pebbles prevent too great evaporation, shelter the young plants in exposed situations, and reflect the light and heat of the sun. The only inconvenience found from them in good soils is that they occupy the room of better earth, and wear out the instruments used, which, in consequence, are made stronger and blunter. When there is a crop to be mown with the scythe, the stones must be removed from the surface, but not otherwise, at least in light soils.

When the land has been duly prepared, the seed is sown. This is done sometimes before the last ploughing, but then the manure should have been ploughed in before; for, except in planting the potato, which is not a seed, but a bulb, the manure should always be deeper, and not in contact with the seed. When the seed is ploughed in, the furrow should not be above two or three inches deep, and eight or nine wide; and it is only in particular soils that this mode is to be recommended. The most common method is to sow the seed on the land after the last ploughing, and draw the harrows over to cover it: when the land has been well ploughed, and especially if the press-drill has followed the plough, the seed will mostly fall in the small furrows made by two adjoining ridges, and rise in regular rows. But by far the most perfect way is, to sow it at a regular depth, by means of a machine, and in rows at regular distances [see Drill], or to *dibble* it, which is an operation performed only in a few parts of England, especially in Suffolk, Essex, and Norfolk. A man makes small holes at the distance of four or six inches, and in rows nine to twelve inches asunder, with two rods about thirty inches long, one in each hand, having an oval ring for a handle at one end, and, at the other, an inverted cone three inches in the axis, and one and a half inch diameter at the base, which he pushes and turns with his hands in the ground to prevent the earth adhering, and makes the holes, rapidly going backwards, along the furrows; two or more children follow and drop three or four grains in each hole; a bush-harrow is drawn over the ground, and fills the holes with loose earth: when the corn comes up, it looks like a regular plantation.

Fig. 8.



[Bush-Harrow.]

The proper season for sowing each kind of grain, the choice of seed, and other particulars, will be given under the name of the different seeds usually sown. As a general rule, it may be observed, that the smaller the seed, the less it must be covered, and clover or grass seed is not usually harrowed in, but only pressed in with the roller.

3. Succession of Crops, or Rotations.—It has been found by experience, that besides the general exhaustion of humus produced by vegetation, especially by those plants which bear oily or farinaceous seeds, each kind of crop has a specific effect on the soil, so that no care or manure can make the same ground produce equal crops, of the same kind of grain, for any length of time without the intervention of other crops. Whether this be owing to any peculiar nourishment necessary to each particular kind of plants, or because plants not indigenous degenerate in a foreign soil, the fact is certain with respect to most crops usually raised, and particularly red clover. This points out the advantage of varying the crops, according as they are found to succeed best after each other. In general, all kinds of grain succeed best after a crop which has been cut before the seed has ripened or the stem is dried up. Those plants which have a naked stem with few leaves thrive best after leguminous plants, which have more succulent stems and more leaves, and which bear their seeds in pods, as peas, beans, tares, or vetches; or after esculent roots, which strike deep into the ground, as carrots, parsnips, beet-roots, and turnips. From this circumstance, confirmed by universal experience, the different systems of rotation have had their origin, taking the nature of the soil into consideration.

The simplest rotation, and one which can only be adapted to the richest strong alluvial soils, is that of wheat and beans, alternately, and without any intermission. It is in use in some parts of Kent and Essex, and in a few places in Germany. The land is well prepared and manured for the beans, which are set or drilled in rows, so as to admit of horse-hoeing between, as in Tull's method, till the beans get to a considerable height; besides this, careful hand-hoeing and weeding are practised, by which the land is cleaned and stirred as in a regular fallow. The beans being cut, the ground is ploughed once, and the wheat sown. It is the practice in some places to scarify the land immediately after harvest, to cut up the stubble. It is done in Kent with a plough without a mould-board, and with a very broad share, hence called *broad-sharing*, but most usually by the scarifier mentioned before: the stubble and weeds, if any, are raked up and burned: this is an excellent practice. Another equally simple rotation, on very poor light land, is that of turnips and barley, alternately, which is mentioned by Arthur Young as being in use in the county of Durham, with the simple variation of clover occasionally. The turnips are always fed off by sheep folded on them. Where winter food for the sheep is scarce, this rotation may answer, but otherwise cannot be very profitable.

The oldest rotation known, and which was almost universal in Europe, from the time of the Romans, wherever any regular system of agriculture prevailed, is the triennial rotation of fallow, winter corn, and summer or lent corn; that is, wheat or rye sown in autumn, and barley or oats sown in spring. This was called the three-field system; and on every farm the arable land was divided into three parts, one of which was in fallow, one in winter corn, and one in summer corn. When properties were much intermixed and subdivided, the whole of a considerable tract was divided into three fields, and it was almost impossible for any individual to deviate from the established course; especially as a right frequently existed of pasturing all the sheep of the parish or district on the fallow field in summer, and on all the others after harvest. In England, this impediment was removed by the legislature passing Acts of Inclosure; but it is still felt in many parts of the Continent. This rotation had its advantages, or it could never have been so long in use. Where a sufficient quantity of manure could be collected by means of cattle fed on pastures and commons in summer, and in the strawyard in winter, to give a regular dressing to the fallows every third year, good crops were produced, and the fertility kept up. The labour was very equally divided throughout the year: and such was the regularity of every operation, that a large quantity of land might be cultivated by a proprietor at a considerable distance, with only occasional inspection, without an overseer or bailiff, provided he had honest servants. But, when pastures came to be broken up, and converted into arable land, and cattle consequently diminished, the land could not be manured on every fallow; the crops suffered; less straw being grown, the quantity of manure was diminished, and the land became gradually less and less productive, till, from necessity, a portion was left uncultivated, and returned to natural and inferior pasture; this gave the idea of laying the land down regularly to grass by sowing seeds, and gradually introduced the alternate and convertible system of which we shall take notice hereafter.

The apparent loss of a third part of the land by the fallows introduced various crops, which were supposed not to exhaust the soil, but rather to enrich it: of this kind, one of the first was clover, introduced by the Flemish; and afterwards turnips, which have been found of such importance in light soils and moist climates. By substituting turnips for an entire fallow, or, more properly, sowing them early on the regular fallow, and interposing the clover between the summer and winter corn, the highly-improved Norfolk rotation has been obtained, viz. 1. Turnips, well manured; 2. Barley; 3. Clover; 4. Wheat: by which a sufficiency of food for sheep and cattle is obtained, without natural pastures, and the land, manured every fourth year at least, is kept in a regular state of progressive improvement. The advantages of this rotation have made it a condition in many leases of light land, under heavy penalties in case of deviation. The first and principal inconvenience found in it was the failure of the clover in most soils, if sown every fourth year; this obliged the farmer to have recourse to other less profitable crops, such as ray-grass, peas, or tares, which, in light lands, are not equal to broad clover as a preparation for wheat. Where the soil is firm and rich, and at the same time mellow, a rotation may be introduced, compounded of the first and last mentioned; that is, beans, wheat, turnips, barley, clover, wheat—making a rotation of six years. This can only be introduced with advantage where there are considerable pastures, and much cattle is kept to supply manure for the land *twice* in the rotation, viz., for the turnips and for the beans, and where the drill husbandry admits of hoeing and weeding thoroughly; but with these advantages, no course can be more profitable, as is found in those parts of Kent and Essex where marsh pastures are attached to the farms. If the soil is too heavy and wet for turnips, and they cannot well be drawn off nor fed on the land, without injuring it, a clean fallow is substituted for the turnips, the other crops remaining the same; or cabbages are planted for the cattle, but seldom to a great extent. A long fallow from after harvest until the second spring, including two winters, prepares the land admirably for barley, so that it can be sown without any manure, which is reserved as a top-dressing for the young clover after the barley. This is a very excellent method. The clover or ray-grass will be more abundant, and the wheat after it will not be in danger of running to straw, or lodging, that is, falling down for want of a sufficient hold of the ground by the roots.

These rotations are sufficient to give some idea of the principles on which they have been adopted. In Scotland they adhere less strictly to particular rotations, nor are the tenants in general so much tied down as in England; seasons and circumstances cause deviations, which are sometimes judicious and often unavoidable. It is best, however, to follow some regular course, and in the end it will be found most profitable. A very common rotation in Scotland is—fallow, wheat, clover or grass, fed one, two, or three years, then oats, peas or beans, and wheat again, if the land is clean and in good heart: for there is no rule better established than that of never allowing the soil to be exhausted beyond a certain point, where manure and tillage can readily recruit it. The greedy cultivator is sure to pay dearly in the end for every crop forced from the land unreasonably.

Without preventing the tenant from using his discretion as to the mode in which his farm is best cultivated, a proprietor may be sufficiently protected against wanton deterioration of the land, by insisting on a green crop or fallow intervening between every two crops of grain, and consuming all the fodder and roots on the farm. For this subject we must refer to the article Farm. A proprietor with skill and experience, cultivating his own land, need only consider the state and quality of his fields, and what will most likely grow well in them; what is most in request, both for his own use and in the market; what will keep his men and cattle in most regular work, without confusion or hurry. If he allows his land to be impoverished for want of manure, or to run wild with weeds for want of hoeing or fallowing, he has not the experience and judgment which are necessary for his pursuits.

The Flemish husbandry proceeds much on this principle. The greatest attention is paid to manuring and weeding. Much more manual labour is bestowed than with us, and the crops seem more certain, varied, and abundant. That it is not unprofitable we may conclude from the wealth of the peasants, the comfort of the labourers, and the sleek appearance of the cattle. From the very interesting account of Flemish agriculture in the work of Mr. Van Aelbroek of Ghent, written in Flemish, translated into French, and published at Paris in 1830, we learn with what great care the soil is cultivated in Flanders. After ploughing into lands as we do, every intervening furrow is deepened and cleared with the spade, the earth being thrown over the bed sown. Liquid manure (which is sadly thrown away in this country), chiefly the urine of animals and drainings of dunghills, is carefully collected, and is carried on and distributed over the poor light soils, by means of water-carts, before sowing, and again when the crop is come up. By this means such lands are made to yield crops of rape seed, clover, lucern, flax, and corn, equal in luxuriance to those on the richest soils. Fallows are rendered unnecessary by the careful destruction of weeds. In short, it is a garden culture on an extended scale. All the land is in tillage, except where rivers occasionally overflow, and render the meadows rich and profitable. The cattle are mostly kept in stables, and fed with green food cut and brought to them; by which means one acre of clover, lucern, or other artificial grass will maintain five times as many beasts, or more, as an acre of the best pasture: but the great object is to increase manure, especially in a liquid state, which is carefully preserved in reservoirs, without loss or waste, till wanted for the land. This system is also followed in Switzerland, which, considering its soil and climate, is one of the best cultivated countries in Europe.

We observed before, that the want of a sufficient supply of manure on the old three-field system led to the laying down arable land to pasture for a time and then breaking it up again. This was first practised in a regular rotation in Holstein and Mecklenburg, and raised these countries rapidly amongst agricultural nations.

In Holstein, on moderately good soil, they adopt the following course:—1. Oats, on newly broken up grass land; 2. A fallow to destroy grasses and weeds, and accelerate the decomposition of their roots; 3. Wheat, with or without manure, according to the state of the land; 4. Beans, barley, or oats; 5. Wheat, manured, unless it has been done for the beans the year before; 6. Grass seeds pastured for three years or more: when the rotation begins again.

A Mecklenburg rotation, not unlike the Scotch, consists of—1. Beans well manured, or potatoes; 2. Wheat or oats; 3. Barley or oats, unless sown the year before; 5. Peas or tares, manured; 6. Wheat; 7. White clover and grass seeds, which were sown among the wheat the year before, and are kept in pasture the 8th and 9th. There is no fallow, and in a moist climate it will be difficult to keep the land clean. It might, however, easily be introduced, as in the Holstein rotation.

Another rotation is—1. Oats; 2. Beans well manured; 3. Wheat; 4. Tares manured; 5. Barley; 6. Clover and grass seeds mown for hay and green fodder; 7 and 8. ditto, fed. All these are excellent for a moderately good soil well managed. If the soil is very rich, the following is the most profitable of any:—1. Rape seed well manured; 2. Wheat; 3. Beans or potatoes manured and hoed; 4. Barley; 5. Clover; 6. Wheat; 7. Oats with white clover and grass seeds pastured two or three years. The principal object in this convertible system is to lay the land down in good heart, and as clear of weeds as possible: the grass will then be abundant, and continue good for several years. Liquid manure, carried upon it in spring, will so enrich it as to admit of making the crop into hay, or cutting it green for the cattle in the stables. In light soils, the tread of sheep and cattle is of great use; in heavy, wet soils, they would do harm. No wet land will bear this rotation.

We have now given a brief outline of the manner in which arable land may be cultivated and improved. If we should be asked, whether so much attention and labour upon land of a proper quality will be repaid by the value of the produce, after deducting the portion due to the landlord, or to the state? we shall answer, without any hesitation, in the affirmative, provided the cultivator is possessed of knowledge, judgment, and experience, and devotes all his time to the superintendence of his farm. The calculations on which this opinion is founded cannot be introduced here; some idea of them will be given in the article FARM. Agriculture is so healthy, so agreeable, and so moral an occupation, that it can never be extremely profitable: the competition for land will always prevent this. The butcher and cattle-dealer will always, if successful, make far greater profits than the farmer; and a decent livelihood, with a moderate interest on the capital laid out, is the most that a farmer can expect, even with the greatest assiduity. If he neglects his business, and leaves it to others less interested in the result, he must be a loser. Gentlemen who cultivate for pleasure, and employ bailiffs, are fortunate if they get a moderate rent after paying expenses. For careless farmers, the simplest system alone can prevent great loss; and grass land may be profitable in the hands of a proprietor, who would probably be ruined if his land were all arable and in his own hands.

Our limits will not permit us to enter into the important subject of improvements,—nor into the question of great or small farms, as most beneficial to the community:—these and various other branches of the subject will be found under proper heads; such as BARREN LAND, FARM, DRAINING, IRRIGATION, MANURE, LABOUR, GRASS-LAND, CATTLE, &c.; and for the peculiar cultivation of the various products of agriculture, see WHEAT, BEANS, BARLEY, CLOVER, OATS, PEAS, &c. &c.

Evelyn, Tull, Hale, Young, and Sinclair are authors whose works may be studied and consulted with advantage by all those who desire to have a competent knowledge of agriculture, either as a branch of general knowledge or for the purpose of its practical application.

BARLEY is a grain too generally known to require a minute description. It is readily distinguished from other grain by its pointed extremities, and by the rough appearance of its outer skin, which is the corolla of the flower closely enveloping the seed, and, in most varieties, adhering strongly to it.

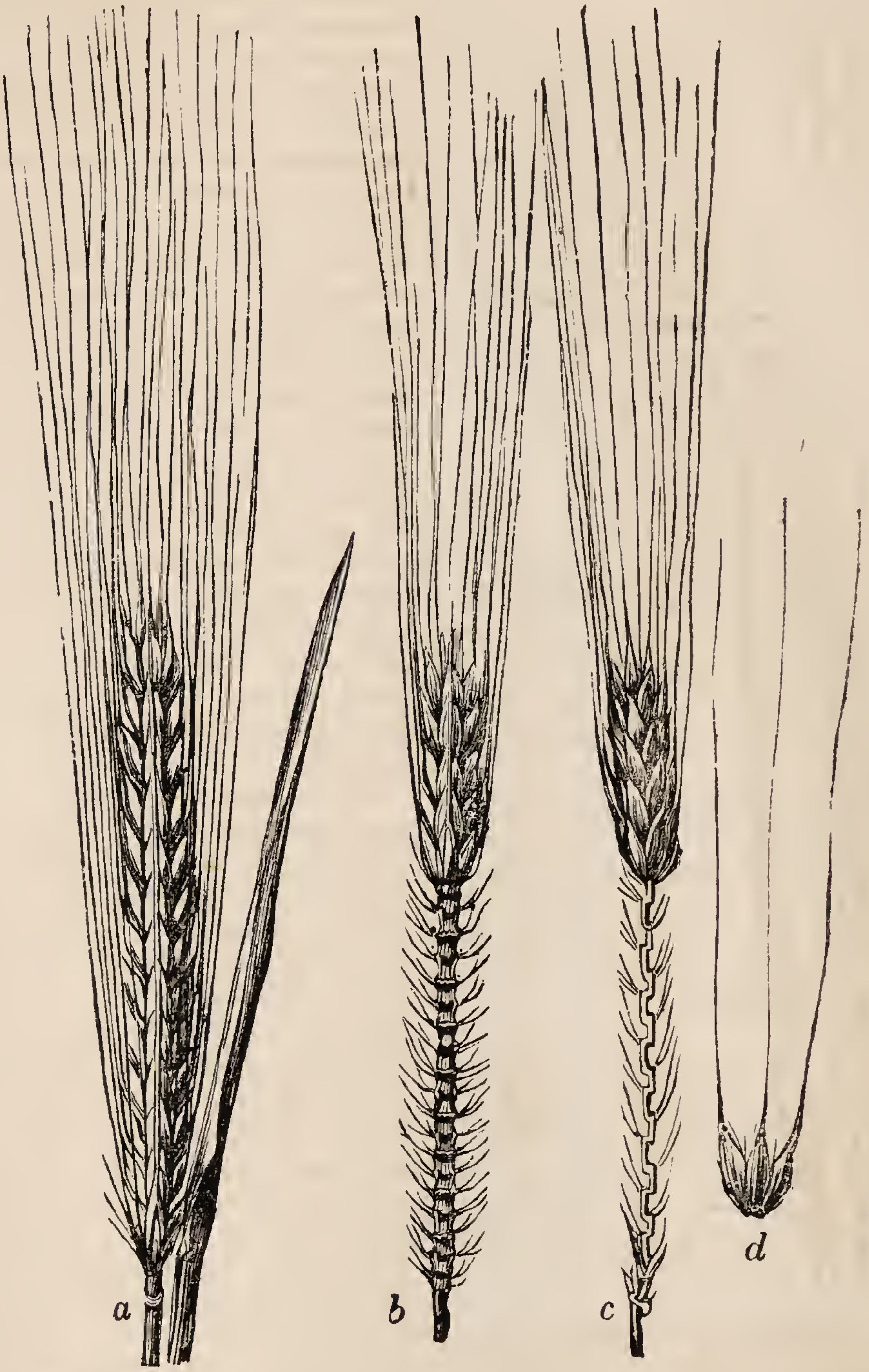
Botanists place barley in the family of the *Gramineæ*, and Linnæus has classed it in the second order of his third class (*Triandria digynia*), having three stamina and two styles in the flower. For its botanical characters, see HORDEUM.

Barley, according to the most ancient authors, formed a principal part of the food of man in the early ages, and continues to do so at this day, in many countries where the progress of agriculture and the increase of wealth have not yet enabled the inhabitants to exchange the coarser barley loaves for the more palatable and nutritious wheaten bread, and where the soil is not well adapted to rye or the climate to maize.

Of all the cultivated grains, barley is perhaps that which comes to perfection in the greatest variety of climates, and is consequently found over the greatest extent of the habitable world. It bears the heat and drought of tropical regions, and ripens in the short summers of those which verge on the frigid zone. In genial climates, such as Egypt, Barbary, and the south of Spain, two crops of barley may be reaped in the same year, one in spring from seed sown the preceding autumn, and one in autumn from a spring sowing. This explains a passage in Exodus (ix. 31), where the effect of the hail is mentioned which desolated Egypt, in consequence of the refusal of Pharaoh to let the children of Israel depart: "The flax and the barley were smitten, for the barley was in the ear, and the flax was bolled; but the wheat and the rye were not smitten, for they were not come up." Commentators agree that this event happened in the month of March; the first crop of barley was therefore nearly ripe, and the flax ready to pull: but the wheat and the rye sown in spring were not yet sufficiently advanced in growth to be injured by the hail.

Agricultural writers in general have distinguished the different species of barley, either from the time of sowing them, into winter barley and spring barley, or, from the number of rows of grains in the ears, into six-rowed, four-rowed, and two-rowed or flat barley. Another distinction may be made between those which have the corolla strongly adhering to the seed, and those in which it separates from it, leaving the seed naked, from which circumstance these are called *naked* barleys. Without entering into any discussion whether these differences are sufficient to constitute distinct species, or are to be considered as varieties produced by climate, soil, or cultivation, we shall only observe that those kinds which are hardier, and will bear the winters of our climate, may also with success be sown in spring, as is the case with the Scotch bere or bigg. There seem, in fact, to be only two very distinct species of barley generally culti-

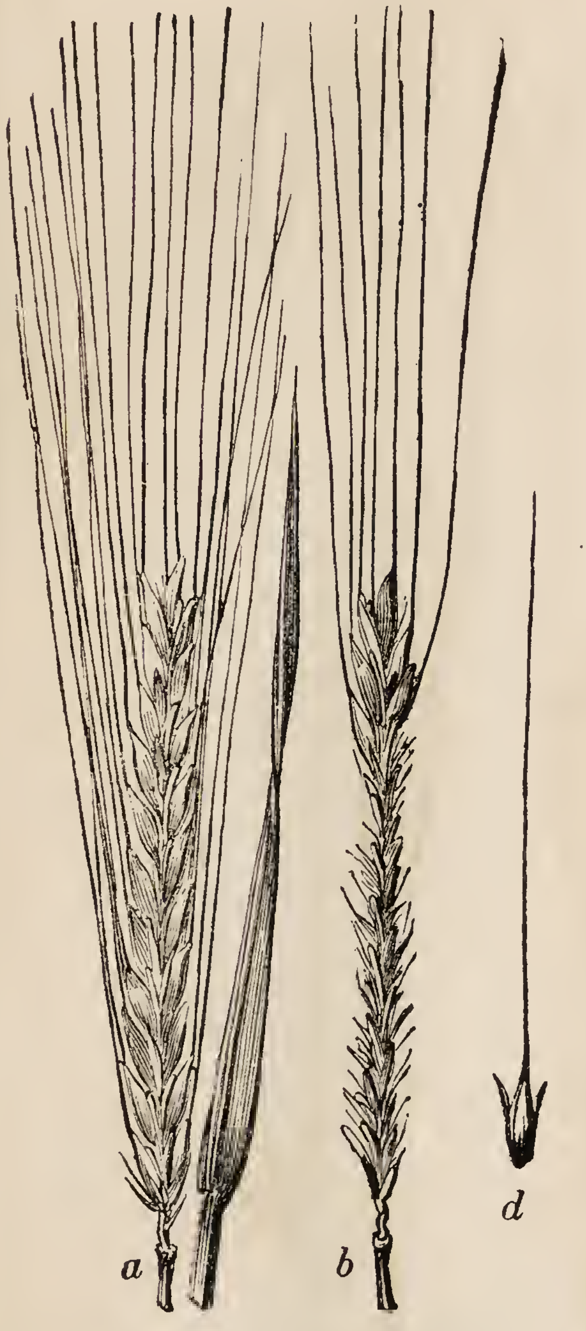
Fig. 1.



a, Winter barley. *b*, The same, with part of the seed pulled off the rachis.
c, A side view of the last, to show the shape of the rachis.
d, The three perfect grains adhering together by the base, as pulled off the rachis.

vated: one which produces three perfect flowers, and as many seeds united at the base, at each joint of the *rachis*, or middle of the ear, alternately on each side (*Fig.* 1); and another, in which the middle flowret is perfect, and the two others barren, forming a flat ear, with only one row of grains on each side, as our common spring barley (*Fig.* 2). The first species has sometimes the middle flowret small or abortive, and consequently only four rows of grains, giving the ear a square appearance, but that this is only an occasional deviation is proved by its returning to the perfect ear with six rows, in rich soils, and under proper cultivation.

Fig. 2.



a, An ear of common spring barley.
b, The same, with the grain partly pulled off.
d, The single grain, with the remnant of the two abortive flowers.

In some varieties of both kinds the seeds stand more apart from each other, and at a greater angle with the rachis; the ear is also shorter, giving it the appearance of a bat or fan, whence it has been called Battledore Barley; it is also known by the name of Sprat Barley. In others the corolla separates from the seed when ripe, and the awns fall off: these are the naked barleys. Each of these has been in repute at different times, and is worthy of the attention and careful cultivation of the practical and experimental agriculturist.

Winter barley is mostly sown in those countries where the winters are mild, and the springs dry, as in the south of France, Italy, and Spain, or in those where the snow lies deep all the winter, and where the sun is powerful immediately after the melting of the snow in spring, as is the case in parts of Russia, Poland, and some parts of North America. In most climates, where the winter consists of alternate frost and thaws, and the early part of spring is usually wet, as is the case in England, Scotland, and Ireland, the young barley is too apt to suffer from these vicissitudes, and the spring-sown barley gives the more certain prospect of a good crop: but the grain of the latter is seldom so heavy as that which has stood the winter, and, being harvested later, it interferes with the wheat harvest, which is an inconvenience.

The winter-sown barley is generally of the six-rowed sort, of which the bere or bigg is an inferior variety, but being hardy, and of rapid growth, it is well suited to exposed situations and inferior soils. The *Siberian barley*, a variety of which, with naked seeds, has been highly extolled by foreign agricultural writers, especially by Thaer, under the name of *Hordeum cœleste*, seems to be a superior sort in rich soils, not only for its heavy and nutritious grain, in which particulars it is said to approach to the quality of rye, but also for its succulent stems and leaves, which make it by far the best sort to sow for the purpose of green food for cattle and sheep, and, if fed off early, the roots will, in a rich soil, shoot out an abundance of fresh stems, and produce a good crop of grain at harvest.

The barley most commonly cultivated in England is that which has only two rows. It is almost universally sown in spring. The varieties produced by difference of soil and cultivation, as well as by seed occasionally brought from other countries, are innumerable; they have been divided by most agricultural writers into the early or *rath ripe* sorts, as they were called, and the late ripe, from the period of their being fit to reap. But this is a distinction which is not very accurate. It is well known that hot gravelly soils bring any grain to perfection in less time than the stronger and colder soils, and that the produce acquires from the soil in which it grew a disposition to ripen earlier or later. This property it retains for a few seasons, by some modification of its vegetating power, to which, for want of a better name, that of *habit* may be given, being analogous to the alterations produced on living animals by habit. Thus seed sown repeatedly in a light dry soil becomes rath ripe, and that sown on the heavy moist land late ripe, although originally the same. The rath ripe grain is always less heavy than the late ripe; and from these circumstances the experienced cultivator of barley chooses his seed from such land as may modify the habit produced by his own, giving him a crop with as heavy a grain as his soil can produce, and within a convenient period.

The common or Norfolk spring barley, so called because it is the principal sort cultivated in that county, has a moderate-sized ear, containing from ten to fifteen seeds on each side on an average (*Fig.* 2). The straw is not very long, and makes good fodder for cattle in winter. Some prefer the long-eared, which contains from twelve to twenty seeds in a row, but it has a weaker straw, and is subject to be beaten down by rains from the weight of the ear. Particular varieties have been in great repute at different times, when first introduced, and then seem to have degenerated and lost their superiority. Of this kind is the *Moldavian* barley. This barley was much sought after some years ago; and lately the *Chevalier* barley (*Fig.* 3), so called from the gentleman who first brought it into notice. It is said that having observed an ear of barley in his field greatly superior to the rest, he carefully saved the seed, and cultivated it in his garden till he had a sufficient quantity to sow it in a field. It has since been extremely multiplied and diffused through the country. Some eminent maltsters and brewers have declared that it contains more saccharine matter than any other sort; and the trials hitherto made have convinced many agriculturists that it is not only heavier in the grain, but also more productive. In 1832 Mr. Coke of Norfolk, who was always foremost in all agricultural experiments and improvements, sowed a considerable portion of land with this barley, and the result is said to have been perfectly satisfactory. In the year 1833 the writer of this work sowed two acres of Chevalier barley in

Fig. 3.

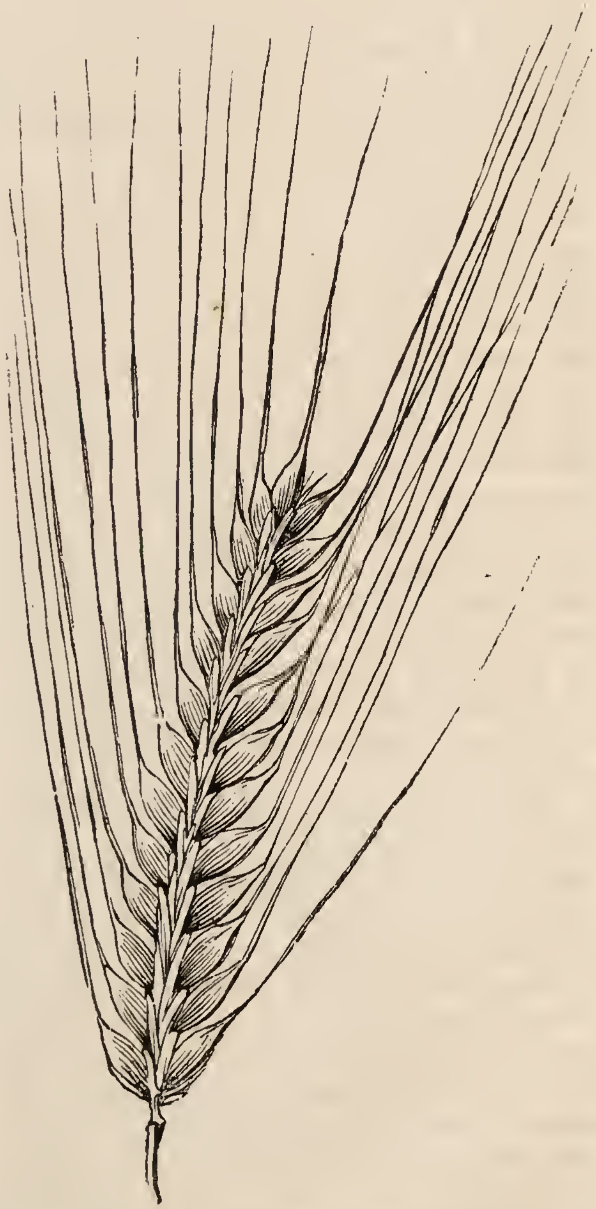
[Chevalier Barley.]

the same field with some of the best of the common barley. The soil was poor light sand, but in good order and very clean. The produce of the whole was nearly the same, four quarters per acre; but the Chevalier barley weighed 57 lbs. per bushel, while the common weighed only 52. This gives the farmer an advantage of nearly ten per cent. The sample was very fine, and the whole that he could spare was eagerly purchased by his neighbours for seed at his own price. It is long in the year and very plump, and the plants tiller * so much, that half a bushel may be saved per acre in the seed. This is probably owing to its grains being all perfect, and vegetating rapidly. The straw, like that of the other long-eared barleys, appears weak in proportion to the ear; it is said also to be harder, and not so palatable to cattle. These are circumstances which experience alone can ascertain. That hitherto it has a decided superiority over the common sorts, no one who has tried it fairly in well-prepared land seems to deny; but unless great care be taken in cultivating picked parcels for seed, selecting the finest ears and plumpest grain, it will probably share the fate of its predecessors—degenerate, and lose its reputation. Might not the cultivation of the various kinds of grain purposely for seed be more generally practised, and form a distinct branch of agriculture? And would not this be well adapted to small occupiers and cottagers, who may have had allotments of land given or let to them, to enable them to live by their own labour and industry, without parochial aid? Thus the good qualities of any grain might be perpetuated, new varieties might be produced, and the defects corrected by cultivation, as is the case with horticultural plants.

The Sprat or Battledore Barley (*Fig.* 4), also called Putney Barley, from having been once extensively cultivated near that place, is in much esteem in Germany. It is the *Hordeum Zeocriton;* also called *German rice*, or *rice barley*, not from any resemblance it bears to rice, but because, when deprived of its skin and made into pot barley, it swells by boiling, and makes a good substitute for rice in broths and puddings. It is not much cultivated in England at present, but it is hardy and productive, and grows well in the stronger soils, especially the marly, and is well worth the attention of experimental agriculturists. It certainly was once in good repute in this country, and may suit particular soils and situations.

All kinds of barley require nearly the same soil, and, whether they are sown before winter or in spring, the ground must be well prepared, and the soil pulverized by repeated ploughings and harrowings,

Fig. 4.



[Sprat (or Battledore) Barley.]

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* A plant is said to *tiller* when it produces several stems from the crown of the root (*Fig.* 5, *a*) at the surface of the soil.

or by the operation of those instruments which have been invented for this especial purpose; in order that the fibres of the roots, which are very minute and delicate, may penetrate the soil easily in search of nourishment.

The cultivation of all the varieties is nearly the same, and is best understood in the counties of Essex, Norfolk, and Suffolk, in which a great quantity of excellent barley is produced and malted for the London market. In the light soils, barley is invariably sown after turnips, which have been fed off the land by sheep, or been drawn to feed the cattle in winter in the yards or stalls, who, by means of an abundance of litter, make a vast supply of manure ready for the next turnip crop. When the land has been properly prepared for turnips [see Turnips], and well manured, and the turnips have been carefully hoed, so that no weeds of any kind remain, it is then in the finest state for barley as soon as the turnips are off. Turnips require a well-pulverized soil, and so does barley. If the soil is very dry and light, the sheep folded upon it consolidate the surface by their treading, and enrich it by their urine and dung. As soon as a part of the field is cleared and the hurdles removed, the land is ploughed with a shallow furrow, and thus the sheep and the ploughs are often seen in the same field succeeding each other, that no time may be lost in turning in and covering the dung, which is very volatile, and would soon lose much of its qualities by the action of the sun and winds. This is sufficient preparation for the seed, which may now be sown or drilled without delay.

In heavier soils, which have become tenacious by the winter's rains, or on which the sheep have been folded in wet weather, the soil may not be in a sufficiently divided state to receive the seed with advantage. In that case it must be worked and stirred till a proper tilth is produced: this is a great loss and hinderance, by increasing the labour at the busy time of sowing, but it cannot be avoided; the experience and judgment of the cultivator must direct him as to the best mode of proceeding, ever bearing in mind that it is an irretrievable error to sow barley on land not properly pulverized, and that, if it is once fine and dry, a little delay in the sowing is of much less importance. It can scarcely be too dry on the surface at the time of sowing, at least in this climate, and, provided a few showers supply the moisture necessary to make it vegetate and spring up, there is no great danger to be apprehended from too dry weather. Barley has been known to grow and ripen, when not a single shower refreshed the soil from the day it was sown to that in which it was reaped.

When the soil is of a strong, compact nature, but fertile at the same time, and turnips cannot well be fed off the land, nor taken off in carts, on account of the damage which would be done to the soft moist soil in winter by the tread of the sheep or the wheels of the cart, recourse is sometimes had to a *long fallow* during eighteen months, from harvest till the second spring, giving the land the benefit of two winters' frosts, a tillage in autumn, in summer, and in two springs. Thus the land is perfectly cleaned, and, if properly managed, quite mellow and fine; and the barley sown on such land always produces a crop, not only abundant, but of the best quality, so that the lines of Virgil in his *Georgics*, i. 48, whether literally applicable or not, are verified in the result:—

> " Illa seges demum votis respondet avari
> Agricolæ, bis quæ solem, bis frigora sensit."

This practice has been alluded to in the article Arable Land, and is common in the heavier soils of Essex and Suffolk. The loss of time by so long a fallow is amply repaid by the state of the land and the subsequent crops. It was once the universal custom to sow wheat after a fallow, and barley after wheat, unless clover was sown with the wheat, which was the first step to improvement; but after the barley another fallow became necessary. By sowing barley after the fallow, the land is much more perfectly cleaned, and the clover sown with the barley is the best preparation for the wheat, which may be succeeded by beans, and, if these are well manured and properly hoed, another crop of wheat may be taken before a second fallow is necessary. By comparing the probable produce of the two different rotations, the advantage will be evident in favour of that which begins with barley.

In some particular cases, however, when a very dry autumn allows the wheat stubble to be ploughed, and well cleaned before winter, and several ploughings and harrowings can be given in spring, barley may be sown with advantage after wheat; but then it is seldom advisable to sow clover and grass seeds with the barley, the land not being sufficiently free from weeds. But the *Trifolium incarnatum*, lately introduced from the south of France, if it should succeed well in our climate, would be admirably adapted to be sown on the barley stubble: the land being slightly ploughed or scarified immediately after harvest, and the seed rolled in. It will grow so rapidly in spring as to smother all seed weeds, and will give a heavy green crop to be cut for horses and cattle early in May, and excellent winter fodder if made into hay. [See TRIFOLIUM INCARNATUM, and CLOVER.]

The quantity of barley sown formerly was four or five bushels per acre: but, if the land is duly prepared and the seed good, from two to three bushels is an ample allowance, especially if sown by the drilling-machine, which it always ought to be; for if the land be too rough to allow of drilling, it is scarcely fit to sow barley in, and oats will be a more advantageous grain.

The proper time for sowing barley depends much on the season and the state of the land. The best practical rule is, to sow as soon after the middle of March as the ground is dry. Earlier sowings may sometimes succeed well, but in this climate, cold wet weather often prevails in the end of February and beginning of March, and this is by no means favourable to young plants of barley. The early-sown crops are however in general the heaviest, especially the sort which ripen later: they require less seed, having more time to tiller before the hot weather draws up the stems. There are, however, seasons when the later-sown crops are the best; a good rule is to sow a quick-growing sort when the sowing is unavoidably deferred, and in this case more seed must also be allowed.

The depth at which the seed should be deposited depends on the nature of the soil and on the season. Winter barley need only be slightly covered, and will tiller astonishingly in good light soils. The examination of two roots, one of which (*Fig.* 5) proceeded from a grain dropped on the surface of the soil, and the other (*Fig.* 6) buried one or two inches under the surface, clearly shows the difference. In the first, the crown (*a*), from which the stems tiller, has the seed still adhering to it; in the other they are separated by a strong tough ligament (*c*). This forms two distinct centres, from which the roots spread; and, in very light soils and dry seasons, the roots, springing immediately from the seed, are less exposed to be dried up. But in stiff soils the seed, buried deep, may have much difficulty in germinating, the air not having sufficient access, and the first shoot, which forms the ligament (*c*), not being able to pierce the compact soil above it. As a general rule, a depth of from one and a half to three inches, according to the nature of the soil, is most likely to enable the seed to sprout well, and give a sufficient hold of the land by the roots to avoid the danger of lodging. It is of consequence that all the seeds be deposited at a uniform depth, to ensure their shoots rising at the same time: for where some rise earlier and some later, it is impossible to reap the whole in good order; some of the ears will be too green, while others are shedding the seed from being too ripe. This is one reason why the drilled crops are, in general, so much more regular in their growth than the broadcast. After sowing barley it is useful to pass a light roller over the land, across the stitches, if there are any, to press the earth on the seed, and prevent too great evaporation of the moisture. When the plants begin to tiller, another rolling, and in some cases a slight harrowing, to loosen the surface and thin out the plants where they grow too close, is very useful. This also is the best time to sow clover and grass seeds, if not done with the first rolling. Barley is not usually hoed, because the land should be perfectly clear of weeds and their seeds before it is

Fig. 5.

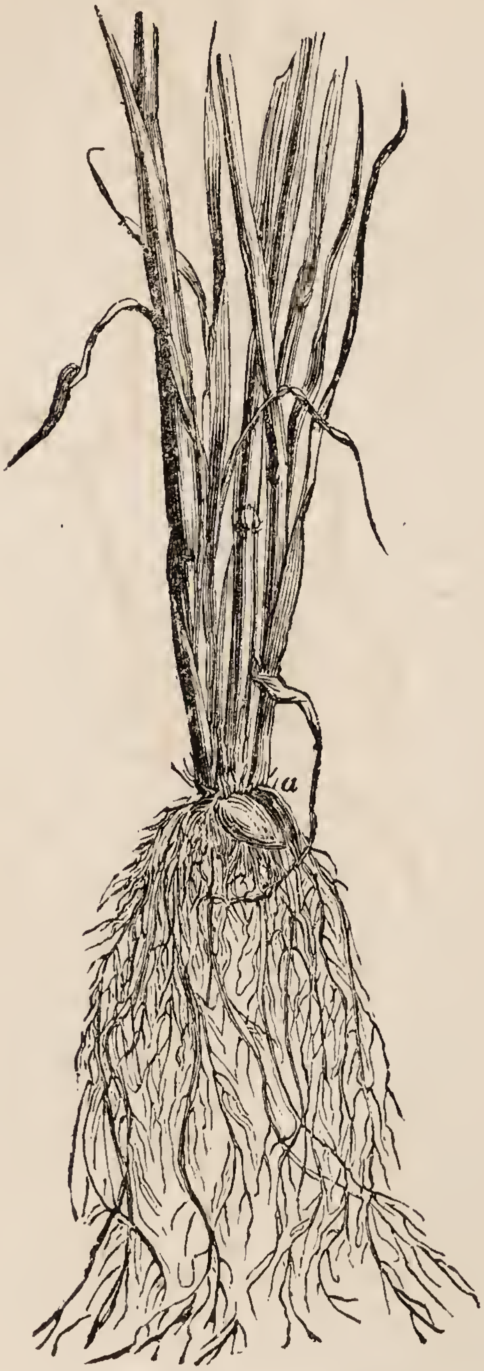
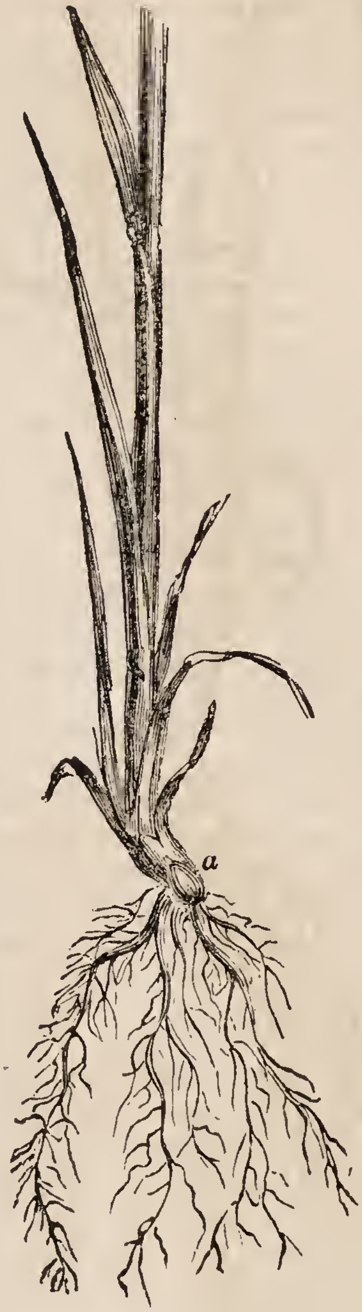


Fig. 5*.



5. A root of self-sown barley in a rich light soil.
5*. The same in a poor stiff soil.

sown; but if hoeing is thought necessary to loosen the soil, instead of merely harrowing it, the clover or grass seeds are sown at the last hoeing. After this no attention is required to the crop till harvest, unless some docks or thistles should make their appearance, which must then be carefully pulled up.

The practice of sowing clover, rye-grass, or other seeds, with the barley, is almost universal, and is considered as one of the great modern improvements in agriculture. There is no doubt a great advantage in having a profitable and improving crop to succeed the barley, without further tillage; and clover prepares

Fig. 6.

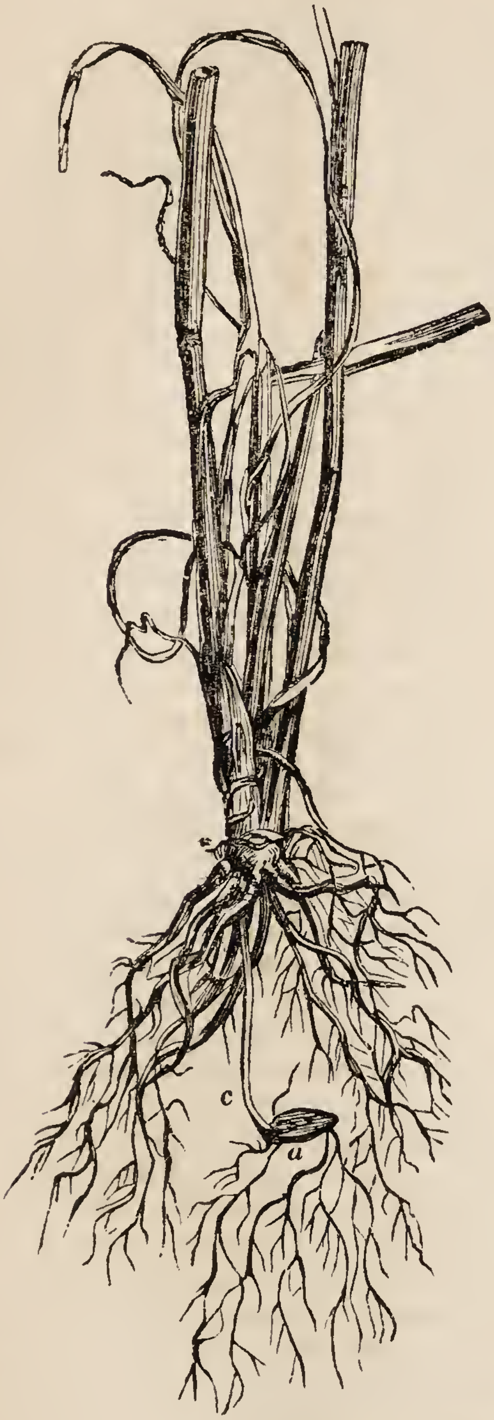
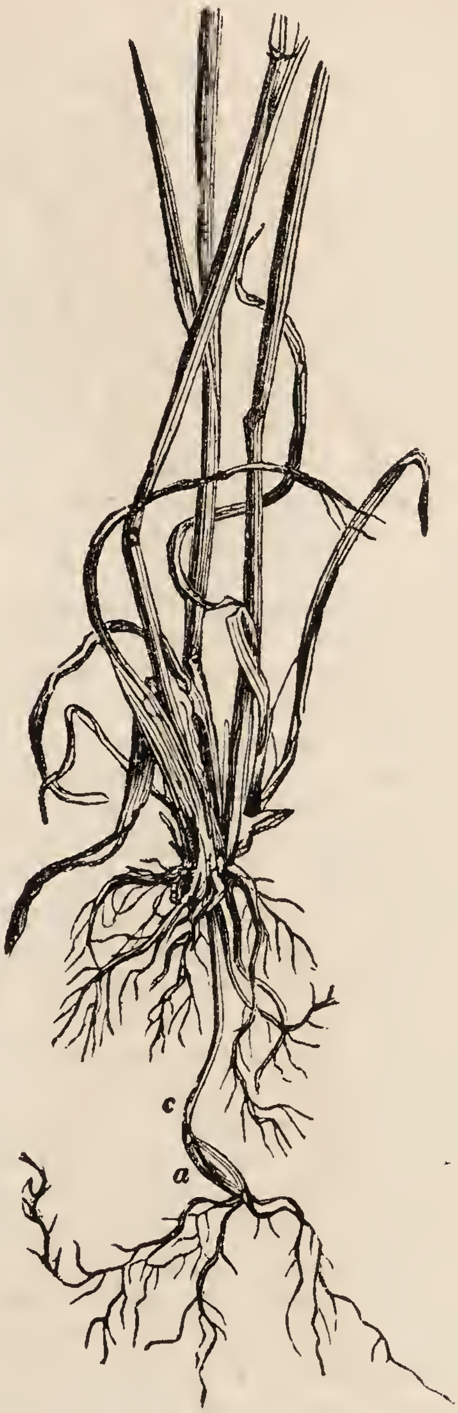


Fig. 6*.



6. A root of drilled barley in a good soil.
6*. The same in a poor stiff soil.

the land admirably for wheat. Still there are some doubts whether this be profitable in all cases. There are seasons when the clover materially injures the barley by its luxuriance; and in wet seasons at harvest it is very difficult to dry the straw sufficiently, mixed as it is with the succulent stems of the clover, or to prevent its heating in the stack. The clover, as far as the barley is concerned, may be looked upon as a weed, which, like all other weeds, must take a part of the nourishment from the crop, and check its tillering. If the clover is sown late among the barley, the danger is less. It will not be able to grow so high as to do much injury, but the fear of losing the plant of clover makes most farmers prefer sowing it soon after the barley.

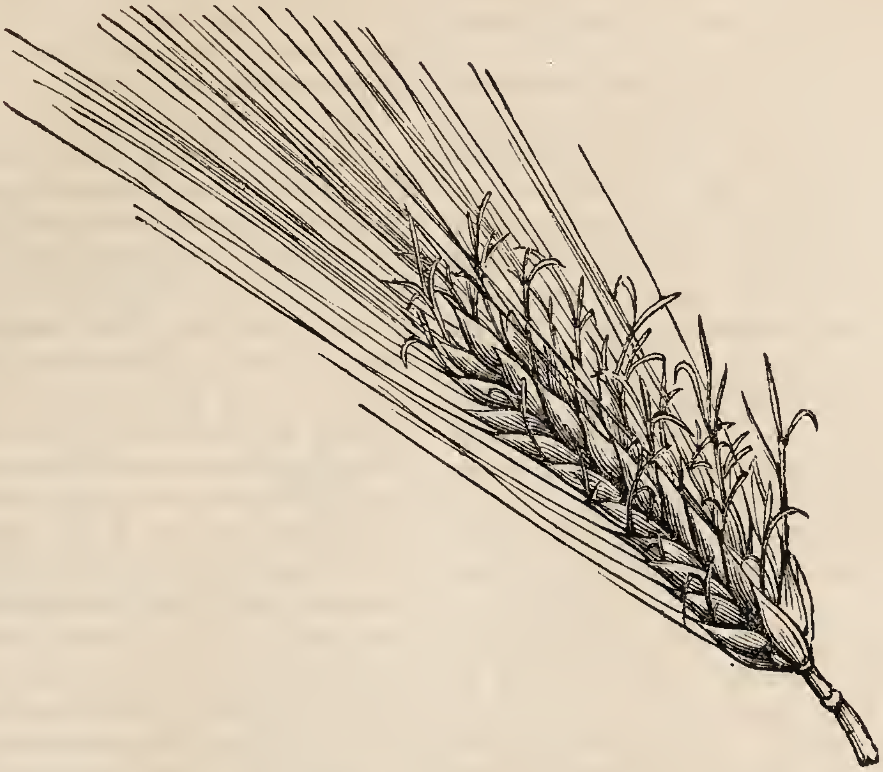
In Flanders, clover is seldom, or never, sown with barley, but chiefly with rye: but they sow a species of white carrot instead, in the sandy soils. These push out very little of the green top, but shoot their fibres downwards, which form the rudiments of the carrot. After harvest, the ground is well-harrowed, and watered with liquid manure. The carrots, which could scarcely be observed above ground, soon spring up, and a good crop is secured before winter, extremely useful for feeding cattle and swine, and greatly increasing the urine of cows and bullocks, the favourite manure for light soils in that country.

As soon as the ears of the barley begin to droop and lose their purple hue, acquiring a light straw colour, before the grain is quite hard, it should be reaped. This is usually done by mowing it with a scythe, having a hoop, or an appendage called a *cradle*, fixed to it, so as to lay the swathe regularly: but where there is a sufficient supply of labourers, at reasonable wages, it is far more profitable to have it reaped with the sickle, or, what is better, with the *Hainault scythe*, a short broad scythe used with one hand, while a light hook is held in the other to lay the straw even, so as to be readily tied up into sheaves. A little practice enables a man to reap twice as much corn in the same time with this instrument as with the reaping-hook. Binding into sheaves is a great advantage; much less corn is shed, which, in the common method of raking into heaps, often amounts to more than would fully sow the same extent of land. The sheaves set up on end are in less danger from the weather, and when the stack is built, all the ears may be laid inward and much grain saved, which, if on the outside, would soon be the prey of birds: smaller stacks may be made, and the danger of heating entirely avoided. The stacks should be built on frames, supported by stone or cast-iron pillars, with flat caps on them to keep out vermin; and, in large stacks, it is useful to have a kind of open cage in the middle, to allow the admission of air to the centre. This dries the grain better than a kiln, and when the stack is properly thatched with straw, the crop may be considered as safe till it is carried into the barn to be thrashed. [See HARVEST, and FARM.]

Barley requires care in thrashing, to break off all the awns close to the grain. A thrashing-machine does not accomplish this perfectly by only once passing the straw through the rollers; it is consequently usually put through a second time, especially if it has not been tied into sheaves. It is often necessary, after the barley is thrashed, to effect this by another operation, which is called *hummeling*, for which purpose several different kinds of instruments are used. A simple one consists of a cylinder composed of small bars of iron, and placed on an axis, which is rolled backwards and forwards over the grain; or, where a thrashing-machine is used, a plate of iron, perforated like a nutmeg-grater, is fixed to the inside of the drum in which the beaters revolve, and the awns are effectually broken off by this rough surface.

The diseases to which barley is subject while growing are those which attack all other grain—the smut, the burnt ear, blight, and mildew; but it is less liable to these than wheat. The greatest enemy is a wet harvest. It is so apt to germinate with the least continuance of moisture, that even before it is reaped it often exhibits an ear in full vegetation, every grain having sprouted (see *figure*). It is then of little value, and even when this is checked by dry weather or in the kiln, the grain is so impaired as to be fit only to feed fowls and pigs. A strong plant of clover, by keeping the wet longer about the barley, often contributes to increase this evil, as has been hinted before.

The principal use of barley in this country, and wherever the climate does not permit the vine to thrive, and no wine is made, is to convert it into malt for brewing and distilling. The best and heaviest grain is chosen for this purpose, and, as it must have its germinating power unimpaired, the least discoloration, from rain or heating in the stack, renders it suspected, and consequently not so saleable. It is, however, still fit for being ground into meal, for



[Premature germination of an ear of barley.]

feeding cattle and pigs, when it is not used for human food; or it may be made into pot barley by the process of shelling. [See Barley, Pot and Pearl.]

The produce of barley, on land well prepared, is from 30 to 50 bushels, and more, per statute acre, weighing from 45 to 55 lbs. per bushel, according to the quality. It is said to contain 65 per cent. of nutritive matter; wheat contains 78 per cent. A bushel of barley weighing 50 lbs. therefore contains about 32 lbs. of nutriment; while a bushel of wheat weighing 60 lbs. contains 47 lbs. Good oats weighing 40 lbs. contain about 24 lbs. of nutritive substance; so that the comparative value of wheat, barley, and oats, in feeding cattle, may be represented by 47, 32, and 24, the measure being the same. It is remarkable that, allowing some addition to wheat, as more generally used for human food, these numbers very nearly give the usual proportions between the prices of these grains. The experiments on which this calculation is founded were carefully made by Einhof, and confirmed, on a large scale, by Thaer, at his establishment at Mögelin, the account of the results being accurately kept.

On all good loamy soils barley is a more profitable crop than oats, and is supposed to exhaust the soil less. On stiff cold clays it does not thrive so well, and there oats are to be preferred. In some districts, where the best barley is grown, the farmers seldom sow oats, and many prefer buying them for their own use, with the additional expense of market and carriage. In Scotland, and some parts of the north of England, oats are in greater request, being the chief food of the labouring classes, and preferred by them to barley, except it be in the form of pot barley in their broths.

Barley in its green state, especially the Siberian winter barley, makes excellent spring food for milch cows, as is well known to the cowkeepers about London; it comes in early, and greatly increases the milk. It is also very good for horses, provided it be given sparingly at first, as it purges them; but after a little time when the stomach becomes accustomed to it, it increases their flesh and condition wonderfully, and is much more wholesome than the usual spring physic, as it answers the purpose of gently clearing the intestines, without any risk of irritation. For sheep it is more nourishing than rye, and comes earlier: when fed off quite close in April, it will spring up again, and, on good land, produce a fair crop of grain in August, but in general it is ploughed up as soon as it is fed off, and succeeded by spring tares or turnips.

Barley has always been considered as possessing medicinal virtues; decoctions of it have long been used for the sick, especially in all pulmonary complaints; and, with the addition of some vegetable acid, it is extremely grateful in fevers, allaying thirst, and giving such a degree of nourishment as is indispensable, without exciting the circulation.

M. Theodore de Saussure has carefully analyzed the ashes produced by burning barley and its straw, and we shall close this article with the result of his experiments. (*Recherches Chimiques sur la Végetation*, Paris, 1804.)

The grain reduced to ashes *with its skin* gave, out of 100 parts, 18 of ashes, which contained:—

Potass	18
Phosphate of potass	9·2
Sulphate of potass	1·5
Muriate of potass	0·25
Earthy phosphates	32·5
Earthy carbonates	0
Silica	35·5
Metallic oxides	0·25
Loss	2·8
	100

1000 parts of the straw produced 42 of ashes, containing:—

Potass	16
Sulphate of potass	3·5
Muriate of potass	0·5
Earthy phosphates	7·75
Earthy carbonates	12·5
Silica	57
Metallic oxides	0·5
Loss	2·25
	100

These products no doubt vary in different soils; but the proportion of silica in the straw and in the skin of barley is remarkable. This barley grew in a chalky soil.

BARLEY, POT, is barley of which the outer husk or skin has been removed.

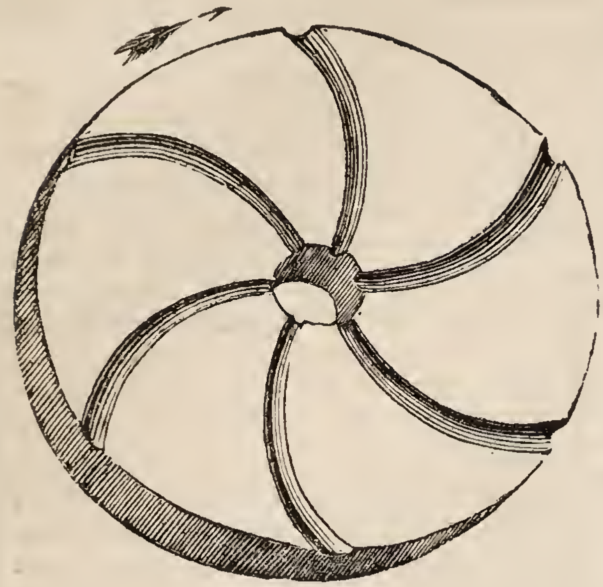
BARLEY, PEARL, is the small round kernel which remains after the skin and a considerable portion of the barley have been ground off.

Both these preparations of barley are made by means of mills constructed for the purpose, and differ only in the degree of grinding which the grain undergoes.

There are two kinds of mills for making pot and pearl barley, which we shall briefly describe. The mill, which was probably the earliest in use, and which is still common in parts of Germany and France, to take off the husk of the barley, is similar to a common flour-mill, having two millstones, of which one is fixed and the other revolves horizontally over it; but these stones are of less diameters than common millstones, not exceeding three feet each. The upper stone has six grooves, in the form of the fourth part of a circle, cut in the lower surface from the centre to the circumference; the width and depth of these grooves increase from one inch in the centre to two inches at the circumference (see *Fig.* 1).

This stone has a perforation in the centre, as a common upper millstone, and revolves on a vertical axis or spindle of iron, the lower point of which moves in a metal cup fixed on an elastic horizontal beam. It is absolutely requisite that this axis be perfectly vertical, and the stones accurately horizontal, in order that the upper stone may move parallel to the lower, at such a distance as to rub the grain without crushing it. The mill is fed by a hopper through the central aperture, as in the common corn-mill. The stones are surrounded by a circular case, leaving a space of from two to three inches between the circumferences. The top or flat part of this case is of wood and has an aperture corresponding with the central aperture of the upper stone; but the circumference consists of thin plates of iron perforated from the outside, by means of a flat punch, with holes, as near each other as possible, making the inside of the case rough, like a nutmeg-grater. A square opening in this case, with a sliding door over it, serves to let out the barley after it has been sufficiently ground. In order to loosen the skin without rendering the substance of the grain too soft,

Fig. 1.



the barley, which is chosen dry and hard, is sprinkled with water on the floor, and turned over two or three times in the course of eight or ten hours: it is then fit to be put into the mill. The upper stone is made to revolve from 200 to 300 times in a minute. The barley, gradually supplied from the hopper, is carried round in the grooves of the upper stone and rubbed on the under without being broken. The centrifugal force, and the strong current of air produced by the grooves and the rapid motion, drive the grain, partially ground, against the rough case, and complete the removal of every part of the skin. It is then let out through the square opening, and falls on a sieve, which separates the naked grain from the bran. This is pot-barley. To make pearl-barley, the operation is continued till the required degree of fineness is produced. As the greater part of the finer particles of the barley ground off escape through the holes in the case, it is surrounded by another to collect this meal; or a cloth is fixed all round, which lets it fall gently in a bin below; thus nothing is lost. This meal is excellent food for cattle, pigs, or poultry. The great objection to mills of this construction is, that they require great nicety in the adjustment of the stones, and are very apt to waste the barley by grinding it unequally, and that, at all events, the larger grains are more ground than the smaller but for pearl-barley, which ought to be of a uniform size, this is rather an advantage. But, on the other hand, the process goes on without interruption, and if two or more pairs of stones are placed under each other, the barley may pass from the first into the hopper of a second, and from this into a third, so as to come out of the last of any required degree of fineness. It may be observed, that the principal use of the upper stone and its grooves is to carry the barley round and throw it against the case, and therefore any hard wood, with similar grooves, will answer the purpose as well as stone; and this is said to be the construction of several of these mills. (See *Nouveau Cours complet d'Agriculture pratique*, Paris, 1820, article 'Orge perlée.')

The other kind of mill, which we shall now endeavour to describe, is in general use in Scotland, where most of the pot and pearl barley used in this country are prepared. It was originally introduced from Holland, whence formerly all Europe was once supplied with pearl-barley, commonly called Dutch pearl-barley.

This mill consists of a common grindstone such as cutlers use, about three feet in diameter, revolving vertically on a horizontal axis. A case, similar to the one already described, revolves on the same axis, and in the same direction, with a slower motion. Sometimes the flat sides of this case, as well as the rim, or circumference, are composed of perforated plates of iron, but this is not absolutely necessary. The barley, prepared as before, is put in by a square opening in the circumference, the slide shut, and the machinery is set in motion, until the barley, tossed between the stone and the case by the double motion, has been entirely deprived of its skin, and is become pot-barley; or till it is ground into the small round shape of pearl-barley. The mill is then stopped, the slide pulled out, and the case being turned so as to have the opening undermost, the prepared barley falls out into the bag or bin placed to receive it. It scarcely wants any sifting, for such is the violence with which the grain has been tossed about, that all that is ground off is driven through the holes in the case, and is collected in a close chamber which surrounds the apparatus, as in the other mill.

The mechanism by which the motions of the stone and case are produced is extremely simple, and will be easily understood by reference to a figure, which, although taken from a portable hand-mill for making pearl-barley, is on the same principle as the larger. This portable mill may also be used for shelling rice.

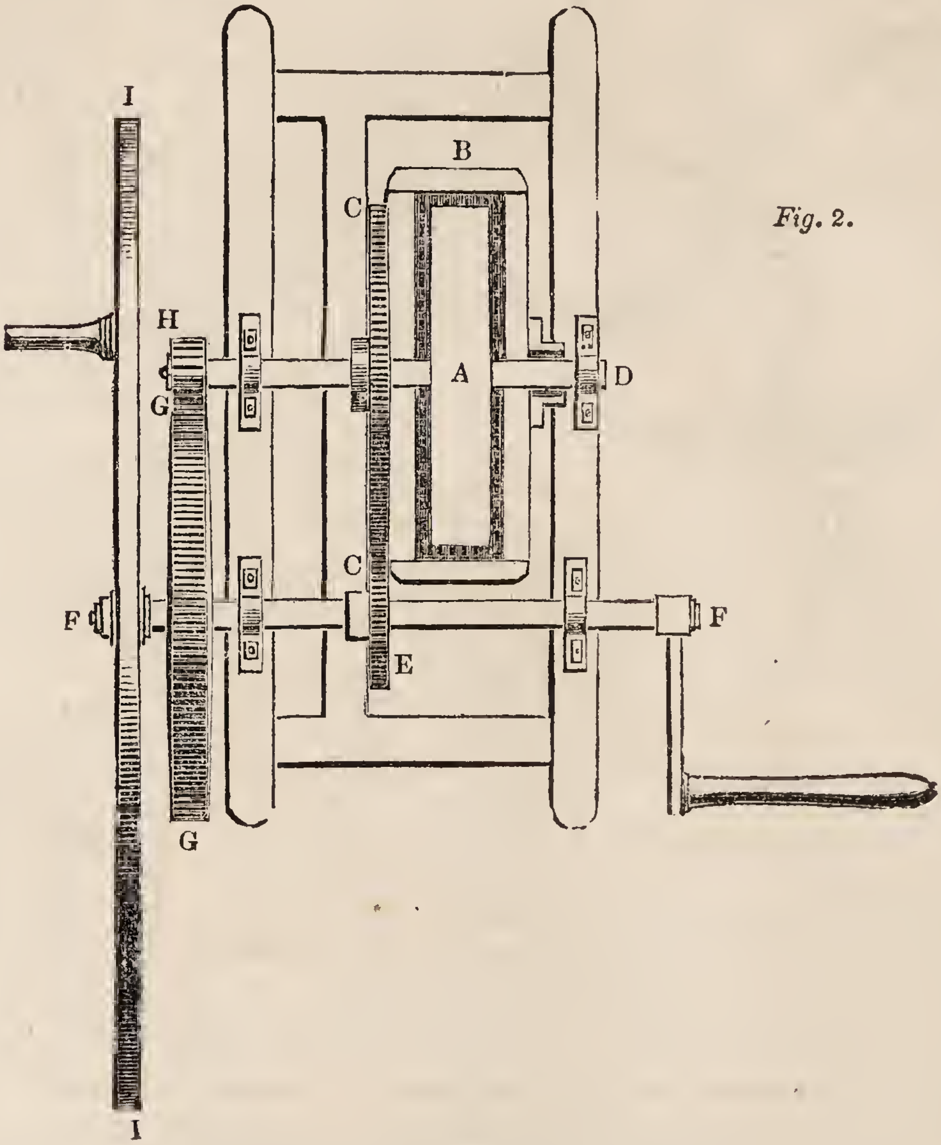


Fig. 2.

[Horizontal section of the Pearl-Barley Mill.]

A, section of the stone turned by the axis D. B, section of the case which turns on the axis D, by means of brass bushes in its centre.

C C, a wheel having sixty teeth, or cogs, fixed to the side of the case.

C E, a smaller wheel, or pinion, with fifteen teeth, moving the wheel C C, and fixed on the axis F F, by which the whole is moved.

G G, a wheel with sixty teeth, on the axis F F, moving the pinion G H, which has twelve teeth, with the axis D D, which carries the stone.

I I, fly-wheel, which equalizes the motion of the whole.

Thus, by turning F F once round, the wheel C C and the case perform one-quarter of a revolution, and G H with the stone, five revolutions: so that the stone makes twenty revolutions for one of the case; and if the axis F turns once in a second, the case turns fifteen times in a minute, and the stone 300 times. This is the usual velocity in large mills. A hand-mill may be moved with one-half or two-thirds of this velocity, the stone being also smaller. When the power is sufficient to turn a stone, three feet in diameter, 300 times in a minute, three bushels of barley may be converted into pot-barley in an hour, and into pearl-barley in two hours.

The advantages of the mill of which a figure is given below are considerable. It requires no very nice adjustment, and is not easily put out of order. The stone may continue in use, although considerably worn down, even to half its original diameter. There is no danger of crushing any of the grains, nor much waste; and whatever be the size of the grains, it grinds them equally. If the pearl-barley is required very equal in size, it may easily be sorted by wire sieves, as the different sizes of shot are. The only defect of this construction is the loss of time and of power which it occasions, by the case being stopped to take out the prepared grain and replace it by fresh barley. Ingenuity will probably find means of removing this defect; but we are not aware of any late improvements in the construction of these mills.

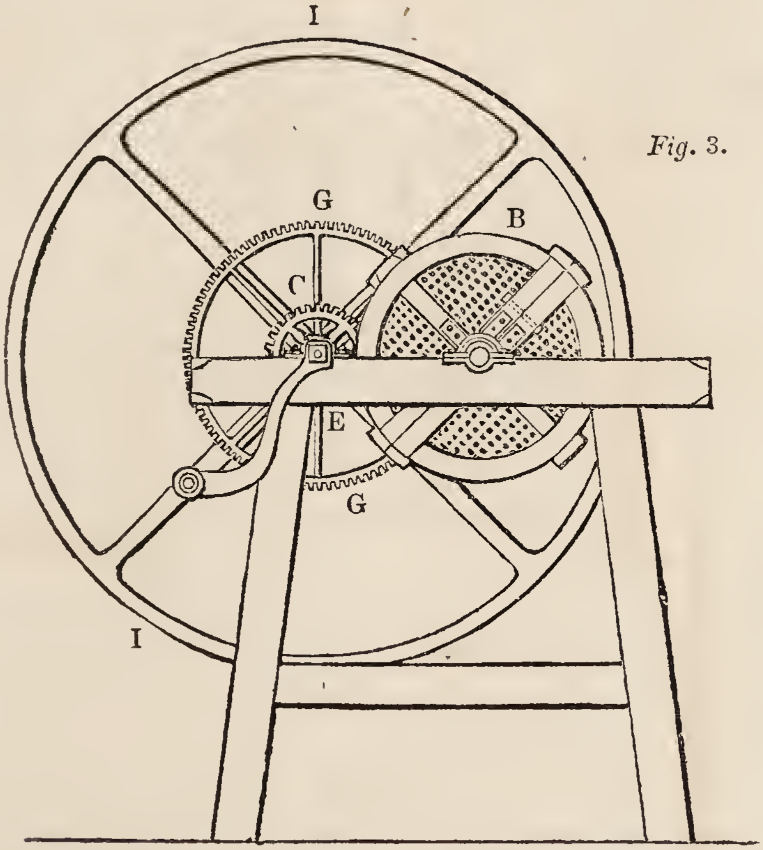


Fig. 3.

[Hand Barley-Mill, with the perforated Plates on the Case.]

Pot and pearl barley are very wholesome and nutritious, and have a more agreeable taste than barley-meal; and it is to be regretted that they are not more used as food by the labouring classes in England, as they are in Scotland, Germany, and Holland. The essential oil of barley, which gives it its peculiar taste, resides chiefly in the skin and adjacent parts of the grain; the interior is a purer farina, more nearly resembling that of wheat. This has probably suggested the idea of removing these outer parts, as less palatable, and given rise to the manufacture of pearl-barley, the farina of which approaches nearer to pure fecula, or starch. This farina, obtained by grinding pearl-barley in a common mill, is sold under the name of patent barley, and used extensively for readily making barley-water for the sick. But if the essential oil of barley possesses any medicinal properties, it is evident, from what was observed before, that common pot-barley would be preferable for making a decoction of barley when prescribed as a remedy. The great use of pot and pearl barley is in broths, stews, and puddings, as a substitute for rice. It swells, and has the property of uniting well with the fat and oily matters extracted from meat in boiling. Barley-broth is a constant and principal dish at every family dinner among the middling ranks in Scotland, and not despised by the higher. Even the bran, having been steeped in water, and allowed to ferment till it becomes acid, is relished by the lower orders in the mess called *sowens*. In Holland, pot-barley, boiled in butter-milk and sweetened with treacle, is a common mess for children and servants; and however unpalatable this may appear to some tastes, early habit and association make this, as well as the *sowens*, a kind of luxury to many.

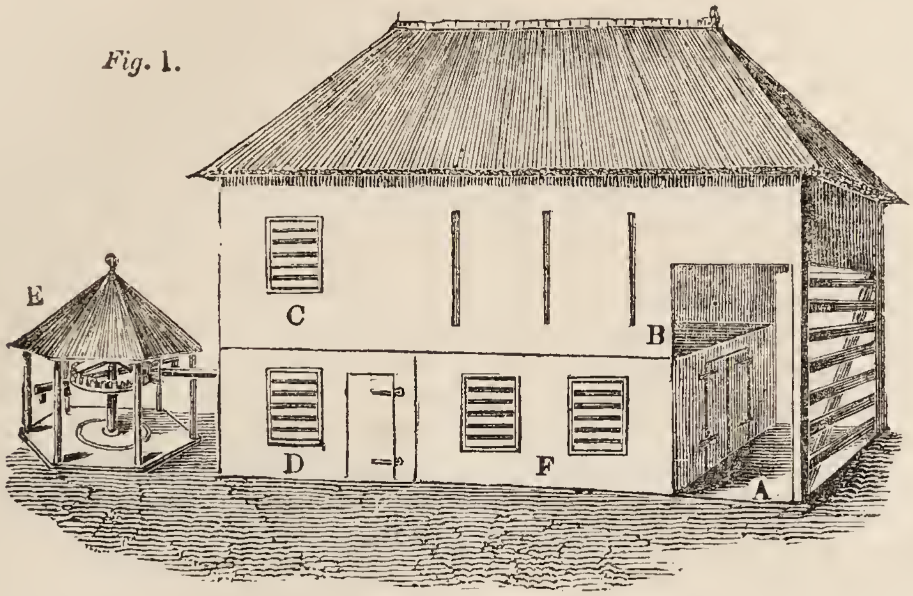
BARN, a building in which agricultural produce is stored, to protect it from the weather, and keep it in safety. In all countries where the climate does not permit the corn to be thrashed in the field and immediately put into a granary, it is necessary to protect it from the weather; and the most obvious method is, to have capacious buildings for that purpose. Accordingly, all well-appointed farms have one or more of these buildings, which formerly were made of such dimensions as to be capable of containing the whole produce of the farm, whether hay, corn, or straw. A great saving has been effected by the mode of stacking hay and corn in the open air, protected only by a slight covering of thatch. In consequence of this improved practice, modern barns are made of smaller dimensions, and their principal use is to contain the corn in the straw which is intended to be thrashed out immediately; so that if the barn is capable of containing a thrashing-floor, and as much corn in the sheaf as is usually put in a single stack, it answers all the purposes of a larger barn; and thus the expense of the farm buildings is greatly diminished.

The shape and construction of a common barn are too well known to require a particular description; we shall therefore only give some idea of the improvements which have been made on the common plan, and of some peculiar buildings, which are extremely useful, and not so generally known.

The principal use of a barn in our climate being to thrash the corn in, its construction must be adapted to the mode in which that operation is performed. As many smaller seeds, such as clover and the grasses, cannot so well be thrashed by a machine, a floor, upon which they may be thrashed with the flail, is an indispensable appendage to a farm; and the barn is the most convenient place to have it in. This floor is commonly placed in the middle, with its length equal to the width of the barn. It also allows the waggons or carts, when loaded with the produce of the harvest, or of the corn taken from a stack, to be drawn over it, and unloaded immediately in the barn. For this purpose large double gates are placed at each end of the floor, of such dimensions as to allow a loaded waggon to be drawn in on one side, and, when unloaded, taken out at the other. When the width of the barn is not sufficient for the length of the floor, a porch is added on one side, or both, and in these the gates are placed. Those parts of the barn which are on each side of the thrashing-floor are called the bays; and in these the corn is placed till it is thrashed. Where there are porches, the roof of the barn is generally brought down to the line of the porch; and thus convenient sheds are formed on each side. One of the defects of this construction is, that the drawing of loaded waggons on the floor materially injures it, even where the precaution is taken of spreading straw over it. In consequence of this, many barns have been constructed without the large gates, and the corn is thrown from the waggon outside, through an opening called a *pitch hole*, into the barn. This has the inconvenience of loss of time, and the risk of damaging the corn in showery weather. The best plan, therefore, is to have a passage for the waggons under the roof, at the end of the barn, where they can with ease and safety be unloaded, and if a thrashing-machine is used, a floor raised about seven feet above the ground will contain the machine at one end, and the unthrashed corn at the other: the lower part may be appropriated to various useful purposes; that part which is immediately under the machine receives the corn and straw after they are separated, and contains the winnowing-machine. (See *Fig.* 1.)

A, the place for unloading the corn;

Fig. 1.



B, a floor seven feet from the ground, on which the corn in the straw is stored; C, the place of the thrashing-machine at the end of the floor; D, a chamber under the floor, into which the thrashed corn and the straw fall, and the corn is winnowed; E, the shed for the horses to work under; F, a place under the floor, in which agricultural implements are kept: it may be converted into a stable. Double gates at each end of A will shut the whole up; or the end B may be closed by a partition with double doors in it. The windows are latticed.

In this case the seeds may be thrashed on the raised floor, which must be made strong and well jointed, to prevent the dust beating through, and steadied by pillars or a partition below. In small farms, where there is no thrashing-machine, this construction is not so advantageous, the raised floor being unnecessary; still it would be better not to draw the waggons on the floor. The thrashing-floor may be placed at one end of the barn, the waggons unloaded at the other, and the corn deposited between them.

A common thrashing-floor is usually from eighteen to twenty feet long, and from twelve to fourteen wide: the size must depend on the number of men who thrash at the same time; this operation being more rapidly performed by three or four men, beating in regular time, than if they worked separately. The labourers generally prefer working singly, but if they are paid according to the quantity thrashed out, they are wrong. The ancient mode of cleaning corn, by winnowing it with the shovel and the fan (see Isaiah, xxx. 24), is still occasionally practised, and requires a great length of floor; but the winnowing-machine with skreens and riddles has now generally superseded this method.

Thrashing-floors are usually made of stone, brick, oak, or tempered earth. The first are the most durable, and where stone can be obtained at a reasonable price, they are in the end the cheapest; but they are apt to bruise the corn, and on that account are not so generally adopted. Brick floors have the same inconvenience, besides that of readily imbibing moisture, and making the grain feel cold and damp, which diminishes the value of the sample. Earthen floors, when carefully laid, and the materials well incorporated, are both cheap and durable, provided the soil on which they are laid is dry naturally, or made so artificially. The following is the manner in which they are constructed. The soil is taken out to the depth of six or eight inches, or more, and, if the subsoil is of a moist nature, a layer of gravel and dry sand is laid on the bottom three or four inches thick, and trod smooth and level. A mixture is made of clay, or loam and sand, with water, to the consistency of common building mortar, to which is added some chalk, or pounded shells, or gypsum, where these can be obtained; chaff, cow-dung, and some bullock's blood are added, and the whole is well worked up together: of this a coat is laid on the prepared bottom with a trowel, about an inch thick, and spread evenly. This is allowed to dry; another coat is then put over, and all the cracks carefully filled up. This is repeated till the desired thickness is produced. When it begins to harden, the whole is well rammed with a heavy wooden rammer, and every crack filled up, so as to give it the appearance of a uniform solid body. This is left to harden slowly, neither exposed to the rays of the sun nor to draughts of air, and in a short time the floor becomes sufficiently hard to be used. It is advisable, however, to give it some months to consolidate entirely. The best time for laying such a floor is in spring, that it may be completely hardened before the succeeding winter. It will last many years, if not exposed to frost and damp. But earthen floors have always the inconvenience of wearing into dust of a gritty nature, which, mixing with the corn, deteriorates it, and renders it less fit to be ground into fine flour. Hence, in spite of the first cost and frequent repairs, oaken floors are generally preferred, and few floors are now laid of any other materials. Some nicety is required in laying oaken floors, that they may not be subject to rapid decay, owing to the confinement of moist air below them. The planks should be two inches and a half thick, the edges well joined by *dowelling*, or *ploughing and tongueing; dowells* are oaken pins of half an inch diameter, and six inches long, driven three inches deep into holes of the same diameter in the edge of the planks, and received into corresponding holes in the adjoining planks, so as to keep them close together, and their surfaces even; ploughing and tongueing is done by means of a groove in each edge, into which a slip of lath is driven, half in each groove. This produces the same effect of joining the planks close, besides completely preventing any dust from passing between the joints. The planks are driven close, by means of wedges, and are laid on oaken sleepers, to which they are fastened by a few iron spikes driven into each, and which rest on a foundation of brick-work, so that the floor is eight or ten inches from the ground. This interval has been sometimes filled up with stones or gravel, under the idea of preventing the nestling of rats; but this is not a good practice. A free current of air under the floor is the only method of securing it from damp, and consequent dry rot. This should be provided by means of openings through the walls, or under the sills: iron gratings will keep out the rats; but even should they find their way under the floor they must be hunted out, and destroyed by dogs and ferrets. By laying barn-floors in this manner, beech, elm, or deal planks may be used instead of oak, and will last many years.

The outer walls of barns are built of stone or brick, or consist only of wooden frames and quarterings covered with boards painted or tarred over.

Where timber is scarce, and neither stone nor bricks can be readily obtained, barns are frequently built with walls of earth, either raised by successive layers, or strata, of tempered earth mixed with chopped straw, or like the composition used for thrashing-floors—(described above)—or of dry earth rammed hard in a frame of boards two feet wide, which in the south of France is called *pisé*. These walls, if properly constructed, and covered with a coat of fine mortar or gypsum, will last a very long time; the only danger is the influence of damp and frost upon them; the roof should consequently project considerably beyond the walls.

The roof of a barn should be constructed according to the approved rules of carpentry, so as to produce the greatest strength with the smallest quantity of timber. This is a point seldom attended to by country carpenters, who imitate the old roofs, in which strong beams resting on the walls horizontally, generally bear the whole weight of the roof, without regard to the advantage gained by proper trussing. Even in the most temporary shed, the strength may be greatly increased by using the materials judiciously. The covering of a barn may be of slate, tiles, or thatch. If tiles are used, they should be laid in coarse hay, to prevent the snow driving through in winter;

this is better than mortar, which requires continual repairs. The most common covering is thatched straw, which has the great inconvenience of affording shelter for rats, who soon nestle in it, and are not easily driven out. The best covering, where it can be procured, is one of reeds, which, when properly laid, will last many years, and in which, from their hard and brittle nature, the vermin can make no lodgment: nothing is a better protection from the weather.

The more the air circulates, the better the corn is preserved. Barns should therefore have numerous windows or openings, and the corn, when put into them, should not be pressed down close to the walls, as is recommended in many agricultural works, but so laced as to allow the air to circulate freely. In this manner it will keep well, without acquiring that close and musty smell which so much deteriorates corn which has been long kept in a barn. Hay is now seldom put into a close barn, experience having shown that it keeps much better in the open air in ricks. But where a considerable quantity of hay is tied up in trusses for the market, it is extremely useful to have a building with a roof to protect them from the wet, and to load the carts under shelter. For this purpose a kind of barn is contrived, which some call a *Dutch barn*, but which may very properly be called a *skeleton barn*, being the frame of a barn without the boarding. The annexed figure will convey a better idea of it than any description. The opening in the middle admits a waggon or cart, to be loaded with trusses, which are deposited on each side. At the time of haymaking, this barn is extremely useful to draw a load of hay in suddenly on the appearance of a shower; and hay put into either side will be preserved as well as in a stack. But for this purpose another building is in use in Holland, to which the name of Dutch Barn is more appropriate, and of which we also annex a figure. This consists of a roof supported by strong poles like masts, A A, on which it can be raised or lowered at will. The usual form is that of a pentagon; the poles are at the angles, and kept upright by means of a strong sill on a brick foundation, and pieces, B, acting as spurs, framed into the poles. The roof is light and covered with thatch. At each angle is a strong block of wood, with a round hole in it sufficient to let the poles pass through; these blocks are kept at any desired height by means of iron pins passed through holes made in the poles, and on which the blocks rest. To raise the roof a small jack is used, an instrument well known by its use in raising heavy waggons when the wheels are taken off. This is placed on an iron pin at some distance below the roof, and the corners are raised gradually, one after the other, at opposite angles, the pins being

Fig. 2.

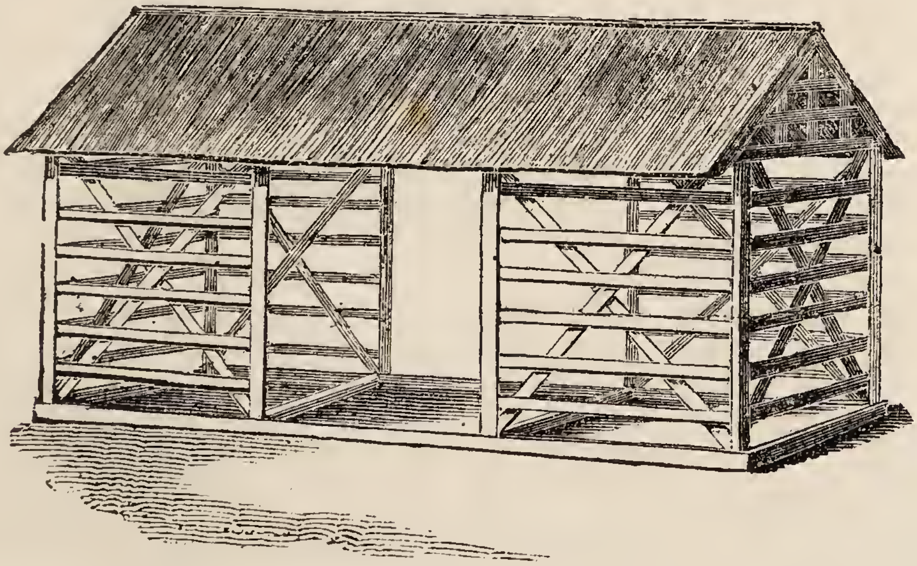
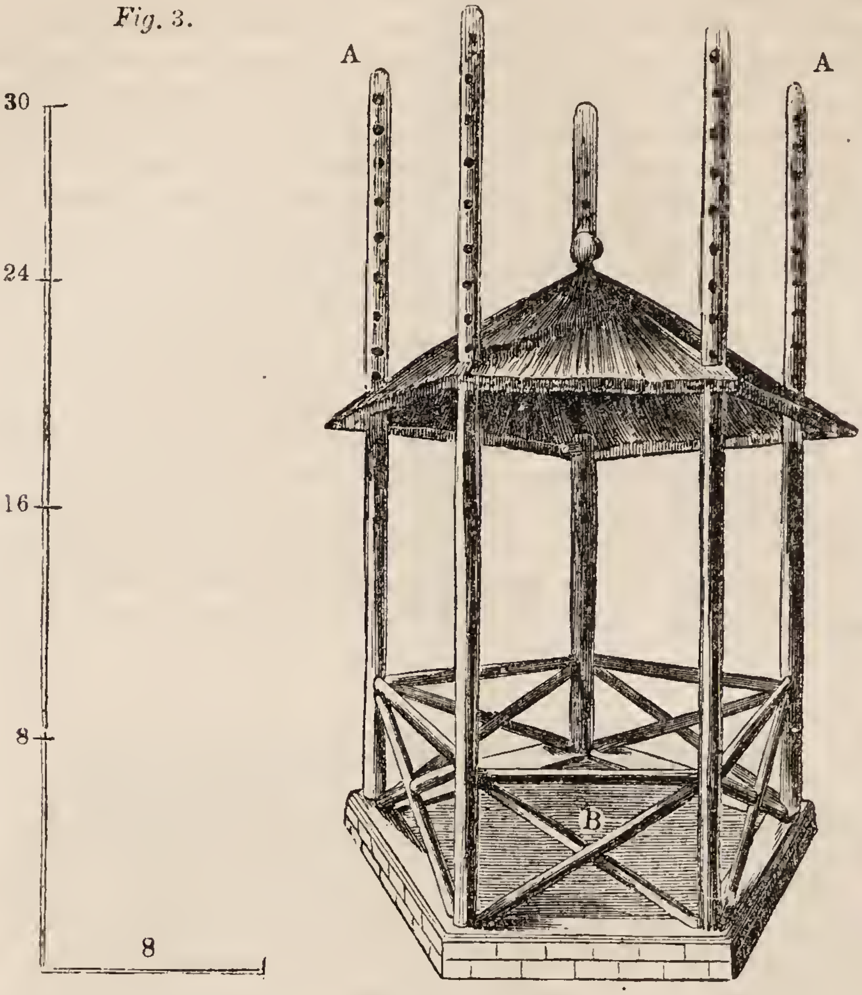


Fig. 3.



moved each time one hole higher.* The chief use of this Dutch barn is to contain hay, which may be placed in safety, in any small quantity, as soon as made, the roof being raised as the quantity increases, and gradually lowered as it is taken off for the cattle, which is always from the top. In small dairy farms in Holland this building is found so useful that few are without one.

BARREN LAND, in agriculture, is that in which the plants generally cultivated do not prosper or arrive at maturity. This barrenness may arise from various causes. The texture of the soil may be such, that the moisture essential to vegetation cannot be retained, or that the fibres of the roots cannot penetrate in search of food. The first is the case in loose siliceous sands, the second in rocks and indurated clays. It is seldom that either of these soils can be rendered productive, so as to repay the expense of cultivation, unless under particular circumstances. The most barren sands will become productive by irrigation, and in that case the labour applied to improve their texture, by the admixture of more tenacious earth, may be fully repaid. The vine may be made to grow in the fissures of the hardest rocks, where the climate is favourable; and terraces may be formed, by which the soil brought on may be retained; but in general loose sands and rocks ought to be left to their natural state of barrenness.

There are, however, in all countries tracts of land which are barren and waste in their present state, and which, for want of better soils to employ and feed an increasing population, are well worth improving, and will ultimately repay the labour bestowed on them.

By the Third Report of the Committee

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* This mode of raising and depressing the roof appears rude, but it is expeditiously done. The French have invented a "*gerbier à toit mobile*," in which the roof rises by means of a screw in the centre; but it does not answer so well.

on Emigration, in 1829, it appears that the soil in the British dominions may be divided as follows:—Taking the total surface of England, Wales, Scotland, Ireland, and the British Islands, at 77,394,433 acres, only 46,522,970 acres were in cultivation, leaving 30,871,463 acres uncultivated or nearly so. Some part of this, no doubt, consists of high sheep-walks, mountains, bogs, and water; but a large portion is capable of improvement, by the application of capital and industry. The particulars are as below, and are given in the *Companion to the Almanac* for 1829:—

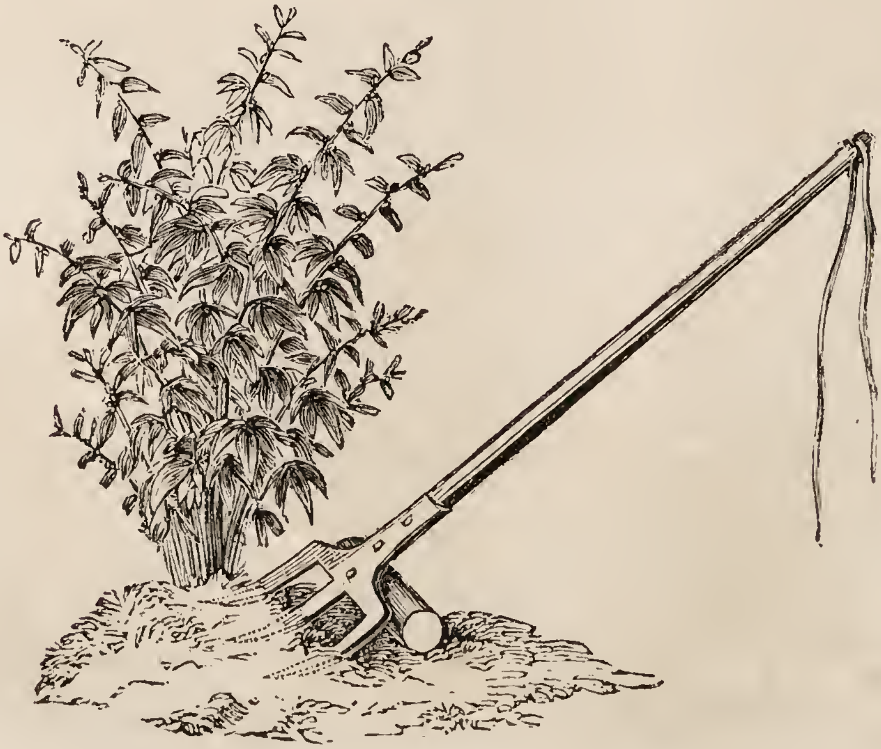
	Cultivated.	Uncultivated.		Total.
		Capable of Improvement.	Unprofitable.	
England	26,632,000	3,454,000	3,256,400	32,342,400
Wales	3,117,000	530,000	1,105,000	4,752,000
Scotland	5,265,000	5,950,000	8,523,930	19,738,930
Ireland	12,125,280	4,900,000	2,416,664	19,441,944
British Islands	383,690	166,000	569,469	1,119,159
Total	46,522,970	15,000,000	15,871,463	77,394,433

Looking at this table, it is impossible not to ask whether so very large a proportion of the surface of the British dominions in Europe may not remain uncultivated more from want of industry and skill than from insuperable barrenness.

We shall endeavour to give, as briefly as possible, an outline of the various means by which even the poorest soils may be rendered capable of adding something to the general stock of food necessary for a large and increasing population. The question as to the policy of cultivating such lands in preference to importing supplies of foreign grain, is not here considered. Our object is to show how barren lands may be improved, whenever such improvement may be deemed expedient.

Some lands are barren in consequence of noxious ingredients in the soil, which by their chemical action on the food of plants, or on their minute fibres, prevent their growth and render them sickly and abortive. These, having been ascertained by careful analysis, must be deprived of their noxious qualities by chemical means, one of the most obvious of which is burning or baking. Nature has supplied a general and complete antidote to acid combinations, in lime, one of the most abundant of mineral productions. There are few bad soils which lime will not improve. The most common substances found in barren soils are different combinations of metals, principally iron, with sulphur and acids; quick-lime either decomposes all these or renders them innocuous. Another substance is *tannin*, or the astringent principle, which is of vegetable origin, and, by preventing the solubility of vegetable fibres, transforms them into an inflammable substance well known by the name of peat or moss. This, likewise, is readily corrected by the same means, and experience has proved that of all substances which can be obtained in sufficient quantities lime is the most valuable as an improver of bad soils. But the different substances of which a soil is composed may be perfectly innocuous to vegetation, and yet the barrenness may not be the less, if the supply or circulation of moisture be deficient or excessive. This must therefore be the first consideration, before any improvement is attempted; and if sufficient moisture cannot be supplied, or superfluous removed, all other attempts will only be lost labour. In tropical climates, irrigation is the chief source of fertility, and the most expensive works have been constructed, both in ancient and modern times, to supply the land with water as occasion requires. In northern and moister climates, the foundation of all improvements in the soil is a proper outlet to superfluous water. These two subjects will be treated in the articles IRRIGATION and DRAINING.

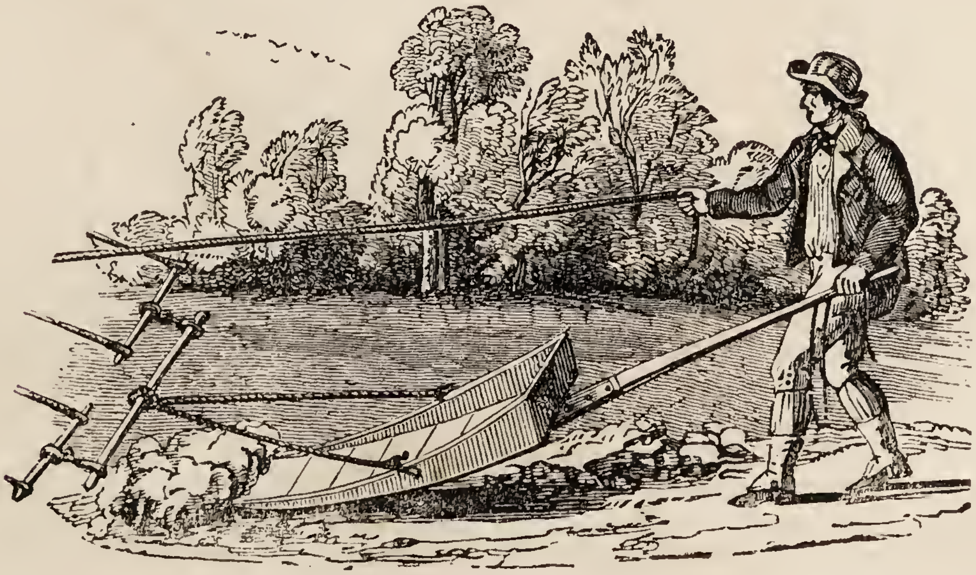
Supposing, then, that the moisture has been regulated, and that the land is to be brought into cultivation, the first thing to be done is to remove obstructions and impediments, whether they be rocks, stones, trees, or shrubs, or only the heath and coarse grasses which generally cover waste lands. Rocks may be quarried or blown, and so may stones too large to be removed whole, and the fragments will often be useful in building the necessary farm offices, or making fences to divide the land into fields of convenient dimensions, and especially to keep off animals from destroying the crops. A simple method of getting rid of large stones is to dig a deep hole by the side of them, as near as possible, and roll them in, so that they may be buried at least two feet below the surface. If they can be removed, this may be done by means of a common triangle with a windlass and pulley, raising them on a low carriage with broad wheels, such as is used for heavy timber. If the nature of the stones is lamellated, and they will split, wedges of soft iron driven into holes made in the direction of the layers readily divide them into flat pieces extremely convenient for use. A very powerful wedge for this purpose is an iron cylinder cut through the axis into two pieces, between which a thin iron or steel wedge is inserted; a hole is bored in the stone of a diameter equal to that of the cylinder, and when this cylinder and wedge are put into it, the wedge is driven in with repeated smart strokes of a hammer. Several such wedges, placed in a line, will split large masses of the hardest granite, and, next to gunpowder, are the most efficacious instruments for that purpose. Trees must be grubbed up by the roots, and it saves labour to cut the roots below the ground while the tree is standing, and draw the tree over by means of ropes fixed to the top; the stem becomes a lever, by which the roots are more easily drawn out. The Bern machine, which has been so often described, was invented for this purpose: it pushes the tree over, and lifts it at the same time. Useless shrubs are readily cut down, and serve for fuel; their roots are seldom difficult to grub up; a simple and powerful instrument for this purpose is a very strong iron three-pronged fork, having



the prongs twenty inches long, and a strong ashen handle, twenty feet long, fixed firmly into it, to the end of which a rope is fastened; this is driven obliquely under the roots, and by means of a log as a fulcrum it forms a lever when pulled down by the ropes.

There are two methods by which the heath and grass of the surface may be got rid of, by mowing them close to the ground, and ploughing in the roots, or by paring the surface and burning it. Each mode has had its strenuous advocates, and has been alternately praised and reprobated. A little consideration will soon settle this point. If the soil consists of clay or loam containing the yellow ore of iron, and if the ashes, after the sods have been burned in heaps, are of a bright red colour, the effect of burning the surface will be generally advantageous, even where the soil is already deficient in vegetable matter; for the fire will do more good in correcting the crude qualities of the soil, than the small quantity of vegetable matter which is dispersed would have done, had it been decomposed in the most favourable manner, and the tough roots of the heath which are reduced to ashes would have taken a very long time to decay, and would have been a constant impediment to the plough. But if the soil is a sharp sand, and the ashes are white and loose, burning destroys the small portion of clay and vegetable matter in the soil, without compensating the loss by any advantage, and in this case burning the surface is inexpedient. The roots of the heath must be grubbed up by spades and mattocks, or by means of a strong plough; they may then be gathered and burned, but the grass must be ploughed in, and not too deep at first, that it may soon rot; a coating of lime ploughed in will accelerate the decay of the grass. This kind of soil requires the addition of vegetable and animal matter to supply the humus in which it is deficient, and the principal attention must be directed to this object.

When the surface is very uneven, so as to form hillocks and hollows, in which the water is apt to stagnate, levelling is a necessary process. The most effectual way of doing this is by the wheelbarrow and shovel, provided the distance to which the earth is to be wheeled does not exceed a hundred yards. The surface should be first pared off, and put in heaps or rows, to be replaced when the operation of levelling has been performed, in order that the best earth, impregnated more or less with vegetable matter, may not be buried under the poorer subsoil. If the soil is loose and sandy, it may be very expeditiously levelled by an instrument in use in Flanders, which they call a *mollebart*. It is a large wooden shovel, shod with iron, having a long handle: about the middle of this shovel, which is convex at the bottom, are two hooks, one on each side, to which chains are fixed, which unite at the bar to which the traces of a horse or horses are to be attached: a

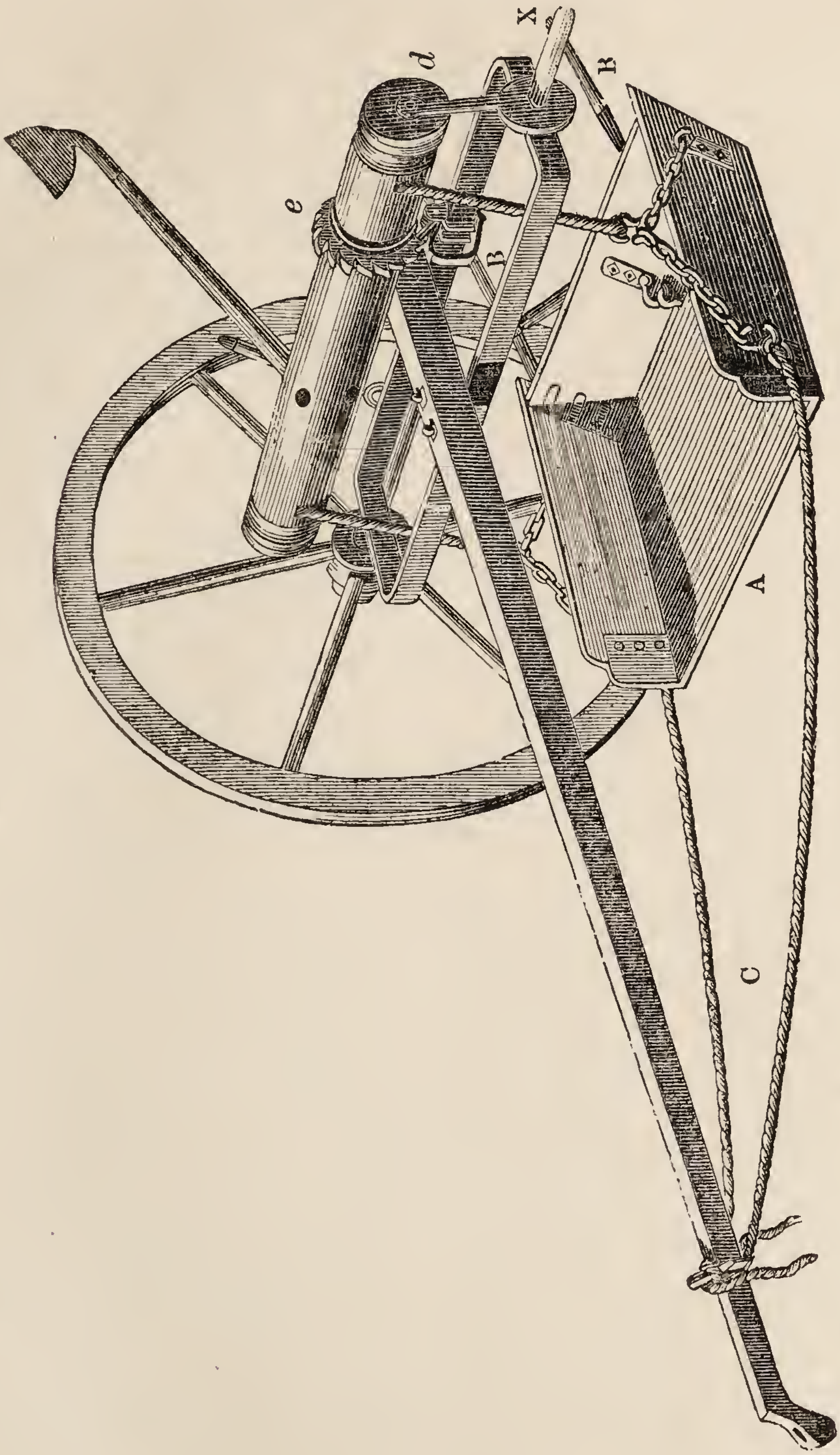


rope fixed to the end of the handle completes the instrument. A man accustomed to the use of it raises the handle, and the shovel enters the ground, and is filled by the horse going on. By depressing the handle, the load is made to slide on the rounded bottom of the shovel, till it arrives at the place where it is to be deposited. By letting the handle go, retaining the rope, the whole is upset instantly, turning over on the edge; the handle strikes on the bar, and the load is left behind in a heap. By pulling the rope, the whole instrument resumes its original position, and is brought back to the place from which the earth is to be taken again, without any loss of time, or the slightest stoppage of the horses. About five cwts. of loose earth may be thus moved at each time. By means of this machine the small fields in Flanders are raised about two feet or more in the centre, and the ground laid convex, sloping in every direction to let the water run off. Thus also the soil of the headlands, which accumulates by the repeated turnings of the plough in our fields, might be carried back to the middle, or spread evenly over the ground. A patent has been lately obtained in France for an improved instrument of this kind, which has two large wheels for such grounds as will not readily allow the *mollebart* to slide over it. It is more complicated, but as it may afford useful suggestions, and be improved and simplified, we give a drawing and description of it.

A is the box or shovel to contain the earth, the bottom of which opens to release the load; B B two handles; C ropes to keep the box steady; *d* a windlass, with *e* a ratched wheel to raise the box when full; X is the axle on which the second wheel runs, which has been taken off to show the construction of the instrument. It is not yet brought into general use, but the experiments made with it are said to have been quite satisfactory.

The land being now enclosed, fenced, and drained where requisite, obstacles to the plough removed, and in a tolerably level state, it remains only to consider how it may be most advantageously cultivated, so as in the end to repay the first and great outlay. Some lands which have lain waste for ages for want of a proper spirit of enterprise, are found to consist of a tolerable depth of moderately fertile earth. These must be treated like a garden newly formed, and trenched as deep as possible; mere exposure to the air and frost will often make them highly productive, and in this case the only caution necessary is not to exhaust them at first; on the contrary, their fertility should be increased by such crops and manuring as will always restore more humus than has been consumed by vegetation. It is too common an error with those who have made a great outlay, to be impatient, and expect too rapid a replacement of the capital laid out. This makes them sow white crops in preference to roots and legumes; and as fresh earth is generally very productive, especially in straw, they imagine the land to be of a better quality than it really is, and soon exhaust it, by which they lose infinitely more in the end than if they began with roots and green crops, and raised a quantity of manure by the stock fed on them. Lime excites new land wonderfully, and no manure is more active, provided there be vegetable matter in the soil or added at the same time. The lime renders the natural humus soluble and active, and, if put on injudiciously, will soon leave none for future crops. Bone-dust will raise a better crop of turnips than lime alone; but bone-dust, or, what is better, coarsely-bruised bones, are chiefly of use in raising the first crop of turnips. They should therefore be used sparingly, unless they can be obtained very cheap, and only on light loams or sands. Mixed with ashes in a heap, and allowed to heat, they become much more efficacious.

But after all the expense of clearing the land and preparing it for cultivation, it may yet be of such a quality as to dishearten the improver. We shall take an example from two kinds of soil very common in all the northern parts of Europe. The one is generally called sandy heath soil, the other is peat or moor, both quite unproductive till they are improved; and yet vast tracts of both have been brought into cultivation, and are covered with a rich harvest, in spite of their natural barrenness. Sir Humphry Davy declared,



on analysis, that the soil of Bagshot Heath, in its natural state, was the most barren soil in England; yet great portions of this barren soil are now covered with thriving plantations, interspersed with green fields. The methods used to bring this land into cultivation will serve as an example for all similar soils. The surface soil of the heath consists of sand, gravel, and light loam, strongly impregnated with a yellow carbonate and sulphate of iron; the subsoil is generally a stiffer loam. The water which percolates the upper stratum dissolves a portion of the iron by means of the carbonic acid, and this iron, mixed with earth, is slowly deposited in a thin layer on the impervious subsoil, where it takes a hard crystallized form, called the *iron pan*, absolutely impervious to moisture; and until this pan be broken, no cultivation can take place. Trenching is, therefore, absolutely necessary wherever this pan exists at a small depth under the surface. A part of the subsoil being brought to the surface greatly improves the texture of the sand, and then the salts of iron must be decomposed and the acid neutralized by lime or chalk. Manure is now the principal object, and, if it cannot be obtained from neighbouring towns, or from old cultivated lands near at hand, the progress will be very slow. Planting trees, especially the fir and the larch, is then the only resource; but where manure and calcareous earth, either in the form of chalk, marl, or lime, can be obtained, the land may be cultivated and improved in the following manner. Lay on a good coating of chalk or marl before winter, and plough it in with a shallow furrow. In spring, plough again deeper, mixing the calcareous earth as much as possible with the soil by frequent harrowings: all the dung that can have been collected must be laid on and ploughed in by the end of May. In June, drill turnip-seed with bone-dust, if possible, in rows not too distant; say twelve inches, if the soil is very poor, but wider in proportion as it is of better quality. These, as soon as they are in the rough leaf, must be carefully hoed till they nearly cover the ground. They must be fed off by sheep in the following winter and spring: the dung of the sheep must be ploughed in with a shallow furrow as soon as possible after the sheep are removed. The quality of the first crop will decide whether a crop of corn may be ventured on in the second year, in which case tartarian oats are found the best suited to such land: but, if the turnips were not a very good crop, a second crop of the same, or of cole, for the sake of variety, to be again fed off, will be much better husbandry; and until the soil shows an evident improvement in colour and texture, the most that can be expected is a crop of turnips and oats alternately. As soon as the ground has, by frequent tillage and manuring, become of a uniform and somewhat mellow texture, the first opportunity must be taken to lay it down with white clover and perennial grasses, and let it remain in pasture two or three years without mowing. When it is next broken up, it may be treated as the old cultivated lands of a similar quality usually are.

If a well-cultivated farm is near, and a sufficient supply of manure can be raised upon it, by converting a portion of it into artificial meadows, or keeping it under green crops, so that an increased quantity of stock may be maintained, the land to be improved may be soon brought into a productive state, without robbing the old land to make the new, as is too often done. Nothing has so rapid an effect in removing sterility as the free use of the urine of cattle, and the draining of dunghills, collected and allowed to ferment in covered tanks; but this can only be obtained by keeping cattle stalled and fed with provender brought to them. This is the great secret of the fertility of the once poor barren heaths of Flanders. In different situations it may not be practicable to procure sufficient manure, at least at first, and the progress will be much slower. In this case the seeds of rye, tares, beans, buck-wheat, and other succulent plants, must be sown, and the crop ploughed in when in blossom: potatoes and other roots may be raised, to be consumed by cattle and swine, in sheds built for the purpose near at hand, and every means that ingenuity can devise must be resorted to in order to make as much manure as possible. This is not to be applied to the land at once, but mixed up in heaps with sods and parings of the surface, with the ashes of roots burned, and with lime, and when thoroughly incorporated by frequent turning, mixing, and repeated watering with liquid manure, a good coat should be put on the land at once, as far as it will go: for one acre brought into a tolerably fertile state will repay the cost better than many imperfectly improved; and by proceeding gradually in this way, more land will be brought into a state fit for cultivation at the end of a few years, and at less expense, than could have been done by beginning with too much at first.

When an attempt is made to bring a large extent of very poor sandy soil into cultivation at once, as may be the case where labour is cheap, it would be impossible to procure the requisite quantity of manure to insure any return for the outlay. In that case there is a simple remedy, which, in the end, is very advantageous; it is, to sow the seeds of broom and furze, which will readily come up, and, in the course of two or three years, not only be of some value to cut for fuel for bakers, but in the mean time have greatly improved the nature of the soil, especially that which has been trenched, by the quantity of vegetable substance contained in the roots and their fibres, and also in the leaves and tender stems which have decayed and dropped during the three years that the land has been covered with these plants. This, at all events, will more than repay the interest of the money expended in trenching, and the future improvement will go on much more rapidly than if the ground had been treated as is recommended above when first broken up. This practice also is taken from our sagacious and industrious neighbours the Flemish.

What has been said of a poor heath, or sandy loam, is applicable to every kind of unproductive soil, difference of composition and texture being kept in view. Poor, wet, stiff lands must be divided by deep ditches, ploughed in high ridges, and be as much as possible exposed to the wind and frost: instead of turnips, grasses must be sown, such as suit the soil. Paring and burning the surface are here generally useful in the first instance, and may sometimes be repeated with advantage. Such soils, in the end, are best calculated for permanent meadows; but it is essential to get them into a sound and fertile state by tillage and manuring, and by clearing them of all the roots and seeds of weeds before they be laid down with grass-seeds, which must therefore be done with a first crop after a clean fallow, or, which is still better, without any crop of corn at all, and kept free from coarser grasses by hand-weeding. *Inoculating* grass is by far the readiest way of producing a permanent sward. [See Grass Land.]

There is another kind of barren soil, which extends over large tracts in northern climates, well known by the name of peat, or moor. This, being chiefly composed of vegetable matter, is too loose in its texture for any vigorous vegetation. But, besides, it is of an insoluble, astringent nature, highly unfit for the increase and nourishment of plants. Moors being generally situated in valleys between mountains, draining off the superfluous water is the first and indispensable operation before any improvement of them can be thought of. The next thing is to compress the soft soil into a more solid state; and for this purpose any kind of earth or gravel is useful by its mere mechanical pressure. The surface may be burned in sods, and the ashes will greatly improve the remainder. Lime, chalk, marl, and shells are the specific correctors of the quality and texture. By the help of these, the soft mass, which can only be stirred with a spade by men standing on boards, is made to produce abundant crops of potatoes and oats; and, gradually condensing, a more compact soil is formed, which soon bears the tread of men and even cattle; and then, properly speaking, the cultivation may be said to begin. The great object is to prevent the absorption of too much moisture by the still unconsolidated mass, which is effected by cutting numerous and deep ditches in every direction, with proper outlets kept carefully open; at the same time guarding against the opposite extreme of drying this spongy substance too much. If it is dry at top, and moist, but not boggy, a foot below the surface, it will be in the best state to improve and consolidate. It is surprising how soon a peat moss, of little more solidity than a bog, can be rendered perfectly firm, and bear even loaded waggons on its surface. It often happens, where there is a command of good water which can be brought above the level of the old peat moss, that it may be converted into a most productive water-meadow. All that is required is, that the upper soil, artificially produced, be not broken through, and that the bottom be well drained.

We have only given brief hints and

outlines to those who may be inclined to render lands productive which have hitherto been barren. The certain cost and probable improvement must be well calculated and compared to avoid disappointment and loss. As these depend on the peculiar circumstances of each case, it is impossible to give any general idea of them. But, by beginning on a small and experimental scale at first, and proceeding cautiously, new modes of lessening the expense of many of the operations will be suggested, errors will be avoided, and some certain practical ground of calculation will be obtained.

That there is a great pleasure in the pursuit no one can doubt, who sees at what expense favourite barren spots are improved; and a scanty harvest on land created, as it were, by art, pleases the proprietor more than the most abundant which his richest lands can produce.

Many a fortúne, no doubt, has been impaired by rash speculations and too sanguine hopes; but, without this spirit of improvement, few soils, except the very richest, would ever have been cultivated, until the wants of a population greater than the richest lands could feed had forced the cultivation of those of inferior quality. It is in the tillage of very poor soils, chiefly, that those improvements in the utensils and operations of husbandry have been suggested and invented, without which a great portion of the soil of the British dominions, and of a considerable part of Europe, could never be cultivated to any advantage, much less afford rent to a proprietor, or contributions to the expenses of the nation.

The unproductive state of waste lands in many populous countries has suggested the employment of the poor and friendless on their improvement, and it has been thought a more enlightened charity to expend the money, which would otherwise be given in simple temporary relief, in such a manner as to make the labour of paupers available to their future comfort and independence. In some places portions of land have been given absolutely, or at a nominal rent, to paupers, in order that they might cultivate and gradually improve them; and where the soil is naturally good, and requires only to be worked and tilled, the plan has been attended with great success. But where a barren waste can only be improved by artificial manures and expensive operations, it is folly to expect this to be done by labour alone, without considerable capital; and neither the judicious managers of public funds nor prudent speculators on their own account will venture to lay out much capital on the chance and with the hope that a naturally indolent and idle class of men shall make it productive either to themselves or those who have advanced the funds.

The establishment of a pauper colony at Frederiksoord, in the province of Drenthe in Holland, noticed by Mr. Jacobs, and of which a short account may be found in the *Companion to the Almanac for* 1829, seems to contradict this opinion; but until we shall have a little longer experience of the working of the plan, we cannot consider this experiment as decisive. The colony must necessarily increase the population, which is already redundant, and may, in the end, produce a seminary of paupers.*

A portion of good land, let at a fair rent to a poor family, with a little pecuniary assistance at first, in the purchase of a cow or pigs, and provisions, until the land produces food for the family, to be repaid by instalments, will occasion much less expense, and will in general be attended with less loss and fewer casualties than the improvement of poor sands and heaths, however judicious may be the management; and the ground converted into a garden will increase much more rapidly in value, than an equal quantity, originally worth nothing, can ever be made worth by three times the labour bestowed. Let the rich then be the improvers of wastes, and the poor lay out their surplus labour on more grateful soils.

It is near increasing manufactures, where land acquires a greater value, that barren land is soon converted into fertile fields. It is there, also, that the improvement of waste lands is most profitable, and the neighbourhoods of Aberdeen, Birmingham, Manchester, and Sheffield, among many others, furnish examples of the greatest industry and perseverance in overcoming the natural barrenness of the soil. Even Chat Moss, between Liverpool and Manchester, which was lately nothing but a quaking body of peat to a great depth, is beginning to be covered with green fields and farm buildings, in consequence of the establishment of the Manchester and Liverpool Railway. To those engaged in these improvements this article may not be altogether uninteresting. We refer for further information to the communications, surveys, and reports made to the Board of Agriculture, and to various articles in the *Farmer's Magazine*, and the *Annals of Agriculture*, by A. Young.

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* Since writing the above observations, we understand that the Belgian government has given up the plan of pauper colonies, of which there were several in Belgium, not having found them to answer the sanguine expectations of those who first proposed their establishment. Those in Holland are not thriving.

In order to encourage the cultivation of poor wastes, and at the same time to secure the right to tithes, when the land should have been fully improved, an Act of Parliament was passed in the reign of Edward III. (2 and 3 Edw. VI. c. 13), by which barren and heath land brought into cultivation, and converted into arable land or meadow, shall pay tithe of corn and hay after seven years from the first cultivation, which seems to release such lands from all claims for tithes during that period, other than had been paid before in its waste state: viz. that of wool, lamb, and the milk or young of cattle depastured on it. But by the interpretation given to the words of the statute in several important decisions, it is only the very poorest soils, which will produce nothing without extraordinary manuring, and which are *suapte natura steriles*, which have enjoyed this exemption; but woodland grubbed up, commons inclosed, fens drained, and lands recovered from the sea by embankments, at a great expense, unless protected by an especial act of parliament obtained for the purpose, are subject to a payment of one-tenth of the produce, or an equivalent composition, from the first year that any crop is produced upon them.

BEAN, a leguminous plant, extensively cultivated in the garden and in the field, classed by Linnæus in the *Diadelphia Decandria*, and by Jussieu among the *Leguminosæ*. There are two distinct kinds of beans cultivated; the one is called the *Faba vulgaris* or *Vicia Faba*, which is our common garden and field bean; the other is the *Phaseolus vulgaris*, the French bean, haricot, or kidney-bean. We here consider them only in an agricultural point of view.

The common bean, of which there are several varieties, bears a pod containing several oblong rounded seeds, which are used in the soft young state for the table, and in the hard dry state for domestic animals chiefly, either whole or ground into meal. In some places bean-meal is mixed with other meal in making coarse bread; or the beans are boiled into a mess with fat meat, in which state they are very palatable and nutritious. The bean came originally from the East, and was cultivated in Egypt and Barbary in the earliest ages of which we have any records. It spread thence into Spain and Portugal, from whence some of the best varieties have been introduced into this country. The most common varieties of garden beans are the Windsor, the Toker, the long-pod, and the Magazan, all productive and well tasted. In the field the tick bean, the common horse bean, and the small Dutch, or Heligoland bean, are preferred, being hardy as well as productive. The long-pod is occasionally sown in the field, the Magazan and broad Windsor bean seldom.

There is no plant in which the transformation of the cotyledons into seed leaves is more readily traced than in the bean. The Windsor bean, in particular, from the size of its lobes and distinctness of its vessels, is admirably adapted for observation, the parts being readily distinguished by the naked eye. If a bean is planted in moist earth or soaked in water, in a moderate temperature, the cotyledons will swell and soon burst the skin which envelopes them, separating into two lobes, which open like the shells of an oyster. In the part which forms the joint an oblong body will appear, which is the embryo stem of the plant. This increases rapidly in the earth, and pushes a root downwards, and a stem upwards, which latter carries the lobes with it till they rise above the ground, when they expand, and are transformed into seed leaves. It is curious to observe the force of vegetation in the young bean when it is, as it were, imprisoned in a strong soil hardened at the surface, as may be seen when a path crosses a field of beans newly planted; the cotyledons, under these circumstances, are drawn into the crevices made by the young stem, where they often remain held fast till the first shower releases them. The change in the cotyledons deserves particular attention. As soon as the seed swells by imbibing moisture, the oxygen, which is always present in the atmosphere and in water, acts upon the farinaceous substance in the seed, and takes a portion of carbon from it, producing carbonic acid, which is absorbed by the surrounding plants, or flies off in the state of gas: by this loss the remaining substance becomes a mild fluid emulsion, analogous to the milk of animals, which, being taken up by the minute vessels of the radicle, nourishes and increases them. It is this alone which produces the first growth; the earth is the mere cradle to protect the young plant and to keep it moist, by preventing the too rapid evaporation which the heat and light of the sun would otherwise produce: when the ground is entirely deprived of moisture, vegetation necessarily ceases. The cotyledons are the reservoirs of nature to supply proper food for the plant in its infant state, as the mother's milk does in animals of the class of mammalia, and the yolk of the egg in birds and oviparous animals. In proportion as the farina in the lobes is gradually exhausted new vessels appear through the substance of the lobes, conveying the newly formed juice from every part of them into the root and stem, and, at last, the cotyledons are transformed into seed leaves. The fibres of the roots are by this time completely formed, and their extremities, called *spongicles*,* from their appearance when minutely examined, have acquired the power of absorbing nourishment from the soil. The plant may now be said to be weaned. The stem is then considerably advanced in growth, having put forth new leaves of a different form from the seed leaves: these last, having now performed their part, wither and soon fall off; if they are removed before this period, the plant, having lost its nurse, languishes and dies.

The bean at this stage of its growth requires particular attention. If the soil is rich and well prepared, it will grow rapidly and luxuriantly, and be soon out of reach of insects or weeds, and capable of resisting the varying influences of the atmosphere; but if the soil is poor and parched, and the supply of nutritive juices is scanty, the plant will soon show weakness and disease, and the only way to prevent a total failure of the crop is to supply by art the deficiency of nature. In very poor soils manure may be applied in a liquid state, or as a top-dressing: in those which are not exhausted, tillage alone will enable the roots to spread, and give them a wider range to seek their food in. The weeds being destroyed, the whole powers of the soil are reserved for the crop; and the air charged with fertilizing vapours being allowed to penetrate the surface, and being retained in the interstices of the soil, greatly assists in invigorating the vegetation. These are the principles on which is founded the whole culture of leguminous plants, whether in the garden or the field. Where labour is not spared and the produce is valuable, as where vegetables are raised as a kind of luxury for the tables of the rich, the greatest attention is paid to the cultivation of beans, so as to have them early and in regular succession during the whole summer. They are even occasionally raised by artificial heat. In general they are sown or planted, at various times, from the beginning of winter to the middle of summer, but they must be protected from frost in the first case, and from too great heat and drought in the latter. They are set in rows with wide intervals, which are kept dug and clean, and in which lesser vegetables are advancing in growth, to be sheltered by the beans, and to succeed them when removed. In order to strengthen the pods already formed, as soon as those which are near the bottom of the stem are filled, the tops of the plants are cut off, and the beans are gathered when the seed has acquired sufficient consistency to be taken from the shells, before they have acquired any farinaceous qualities. One crop is made to succeed another by regulating the times of sowing; and thus beans are gathered for the table from May to November, or till the frosty nights check the growth of the plant. The cultivation of the field bean is only as perfect an imitation of the garden culture as circumstances will permit. As only one crop is required, and that in a perfectly ripe state, when the seeds are fully formed and hard, they are sown at one particular season, so as to avoid the danger from frosts and ungenial weather in spring, and at the same time to have the crop ripe in good time to be harvested before the cold and wet season sets in. The usual mode is to drill them by a machine, at the distance of from twenty to thirty inches, according to the richness of the soil, or to dibble them by hand, either singly or by putting four or five beans in each hole, increasing the distance of the holes from six to twelve inches. Beans are tolerably hardy, and will bear moderate dry frosts; but they suffer much from alternate frosts and thaws, which in this climate are so common in February. The end of February or the beginning of March is therefore generally preferred for bean-sowing. When the season is remarkably mild, as was the case in 1834, early sowing is a great advantage. The writer of this article planted a field of beans on the 1st January, 1834, in a soil duly prepared; they were reaped in August, and produced a very good crop: his neighbours, who planted their beans in March, had not half the quantity on equally good land, owing to the dryness of the summer. But this was an experiment which succeeded: had severe weather come on in February, the whole crop might have been lost. As a general rule, beans may be sown from the middle of February to the middle of March. The sorts usually cultivated in the fields are the tick bean, the horse bean, and the small Dutch or Heligoland bean. In some situations the Magazan and the long-pod have produced good crops in the field: the first three are however best suited for general cultivation. There are several varieties of these, which differ but little in their appearance: experience is the best guide in choosing the seed which suits particular soils and situations. The small round regular-shaped beans are generally preferred, as obtaining the best prices in the markets, especially in large towns, where there is a great consumption of beans by hard-working horses.

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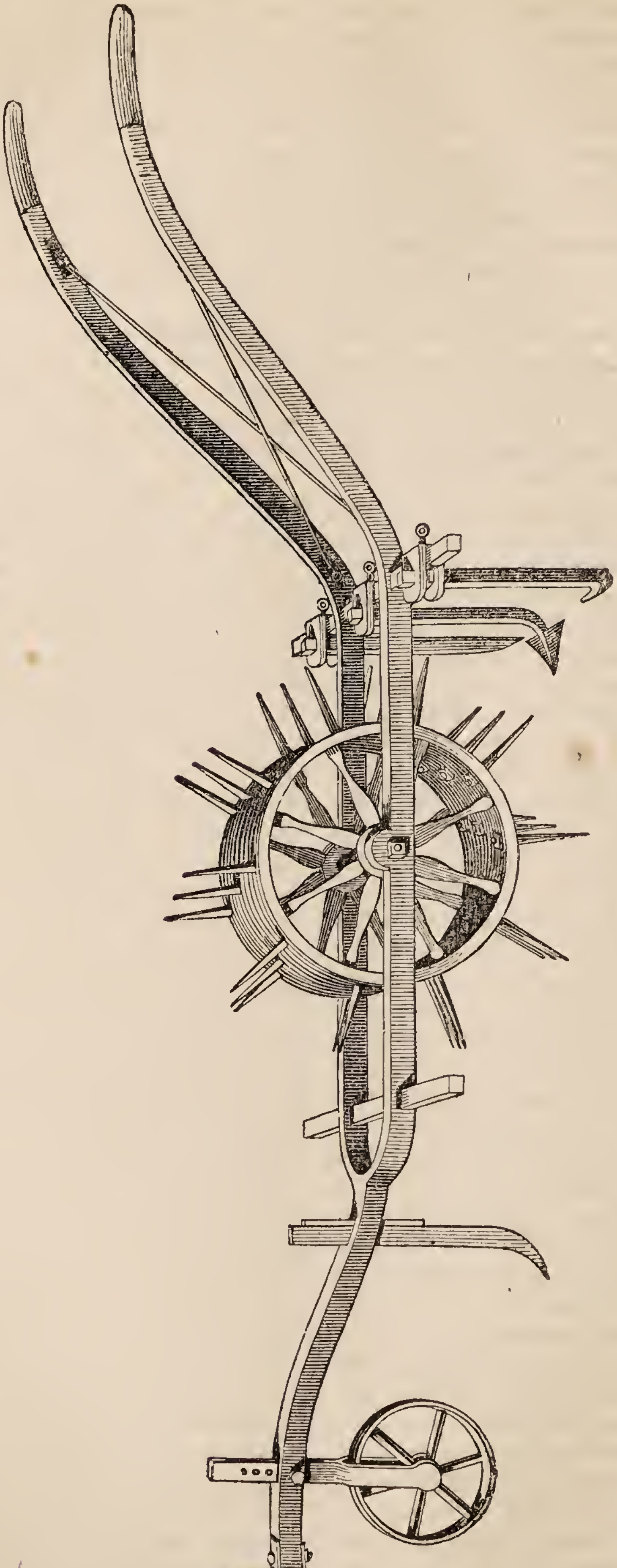
* *Spongioles*. At the extremities of the smallest ramifications of the roots may be seen, by means of high magnifiers, small bodies, which seem to be enlargements of the minute fibres of the root: they are called *spongioles*, from their resemblance to a *sponge*. Their use is to draw in the juices by which the plant is sustained and increased. They possess a vital power, by which they more readily absorb some fluids than others, and are by some thought to have a power of selection, as the lacteals have in the intestines of animals.

The soil best adapted for beans is a rich strong loam, such as produces good wheat. In such a soil the produce is sometimes fifty or sixty bushels per acre, but an average crop, on moderate land, is about half that quantity. On very rich land beans have produced extraordinary crops, by being sown broad-cast and very thick, the stems being drawn up to a great height in favourable seasons. A small field of very rich land, in the county of Sussex, was sown in the year 1832 with four bushels of the small tick bean, which came up so thick, that the proprietor thought of thinning out the plants by hoeing; but he was advised to see what the produce would be, and when they were threshed out there were ten quarters and one bushel of beans. He had the ground accurately measured, and it was found to be one acre and twenty-nine perches, which makes the crop above sixty-eight bushels per acre. They completely smothered all weeds, and the subsequent crop of wheat produced five quarters to the acre; but this particular example of sowing beans broad-cast we do not hold up for general imitation. By cultivating the beans in rows, and by careful hoeing and manuring, alternate crops of wheat and beans may be raised for many years, without intermission, or any necessity for change or fallow: this has been long the practice in the richest part of Kent. In this case the beans must be drilled or set in rows, with intervals of from twenty-four to thirty inches between the rows; and the intervals must be repeatedly stirred and hoed with proper instruments, so as to prevent the growth of weeds and keep the soil in a perfectly clean and mellow state; the weeds which rise in the rows are removed by hand. Immediately after bean harvest the land is scarified, or skimmed over with a plough having a very broad share, whence the operation is sometimes called *broad-sharing*. All roots of weeds and the remains of bean-halm are collected and burned, or put in a heap with quicklime, to be converted into manure. The ground is then ploughed once or several times, according to circumstances, and wheat is sown about the month of October, either broadcast or by means of a drilling machine, in rows ten or twelve inches asunder, which gives greater facility for hoeing and weeding the crop when necessary. The wheat which follows beans is generally good and heavy, and seldom runs to straw. After wheat-harvest the stubble is ploughed up and turned in with a very deep furrow; the land is harrowed flat, and a good coating of manure is put on in a moderately rotten state, and this is covered with a shallow ploughing; the land is well water-furrowed and left so till spring, when the beans are drilled in the mellow surface produced by the winter's frost. This is the most approved practice; but many experienced farmers vary it according to the varieties of soil, or according to difference of opinion. Some put on manure for the beans in spring, and some drill the beans in every second or third furrow after the plough; but all good farmers agree in manuring the land for the beans and carefully hoeing them. It is evident that a different method is required in different soils, varied according to their texture and situation. Alternate crops of wheat and beans can only succeed, for any length of time, on soils peculiarly favoured. In general, a change of crops and occasional fallows will be indispensable to keep the land perfectly clean and in good heart.

In cold wet soils beans require great care to insure good crops. Although they will grow well and seem to flourish in the stiffest and most unsubdued clays, they will seldom produce much at harvest, unless the land has been well prepared and the cultivation managed with skill. There is no better criterion of the experience and industry of the farmer of cold, wet clays than the appearance of his beans at harvest; and he may be judged by this crop, as the farmer of light, sandy soils may be judged by his turnips. The cultivation of these two opposite kinds of inferior soils will, in general, be profitable or otherwise in proportion to the produce of the beans in the one, and the turnips in the other; the first being a substitute for clean fallow, and the latter the foundation of all the succeeding crops. The bean, by its strong and penetrating root, opens the stiff soil to the influence of the atmosphere, by which the surface is dried and at the same time mellowed. Although the nutritious matter in a good crop of beans is great, and almost equal to that obtained from a crop of wheat, it exhausts the soil much less: its succulent stems and leaves absorb much nourishment from the atmosphere, and the latter falling off and decaying, restore carbon and mucilage to the soil, and make up for the inferior quantity of manure produced by the bean-halm in comparison with wheat straw. There is perhaps no crop, bearing seed, which gives so great a return with so small an expenditure of the nutritive juices of the soil; and certainly none that repays manure better, or leaves the land in a better condition for wheat or oats. It is a very common practice to plough a stiff soil in spring only once, after it has borne clover, grasses, or wheat, and to drill beans in the furrows immediately after the plough, by hand or by an instrument; in this case it is best to deposit the beans as near the angle of the furrow as possible, and in every second furrow only, that they may rise regularly at a proper distance. In spite of the tough slues which the plough turns over in a mass, the force of vegetation in the bean makes it pierce through them, and, under favourable circumstances, a tolerable crop is sometimes obtained; while the more industrious neighbour, who has tilled his land in autumn and again in spring, by repeated ploughings, and made it fine and mellow, may be disappointed in his crop by untoward variations of weather. The slovenly farmer then laughs at the more perfect system of the other, pretending that it is wrong to work strong soils so much and make them *too fine*, as the term is. Thus the progress of a whole district in rational and improved culture is arrested or checked by the apparent evil of frequent ploughing. But the conclusion is founded in error. There can be no rule better confirmed by experience than that adhesive soils should be stirred and divided as much as possible; but this must be done with due regard to circumstances and seasons, and the differences in soils: chalking, marling, or manuring, are necessary, in order to prevent the divided soil from *setting* into a hard compact mass. Light coloured clays which consist of siliceous sand and argillaceous earth only, without any intermixture of other substances, set the harder in drying the more they are stirred; after being ploughed they soon have the appearance of stripes of unburned brick; and if a heavy shower has fallen after the land has been harrowed, they become hard like a barn-floor. It is of no use to pulverize such land, until its texture is altered by chalk, marl, dung, or ashes: and the safest way is not to stir it too much, as no good crop can be expected, at all events, till it be ameliorated. To prepare a middling stiff soil for beans, it should be ploughed into high and narrow lands in autumn, with numerous and deep water-furrows, so that no water may lie on any part of it, and, if possible, it should be manured with long dung before it is ploughed. In spring, if there has been some frost, the surface will be loose and mellow: in this the beans should be drilled or dibbled by hand, and a time should be chosen for hoeing them, when the ground is neither wet nor dry, so that the hoe, whether hand-hoe or horse-hoe, may penetrate two or three inches below the surface to open the soil and destroy the weeds. The hoeing of the beans is a most essential part of the culture, and according as it is well or ill executed the land will produce more or fewer crops after it without its being necessary to have reçourse to a fallow. Objections have been made to the use of the horse-hoe and scarifier between the rows in stiff soils, because, when the ground is dry and caked, the hoe raises large clods and lays the roots bare, sometimes even destroying the plants. But there are means of preventing this: if the ground is repeatedly hoed when not quite dry, it will not bind into a hard crust or rise in clods; and should a sudden dry wind, after much rain, bake the surface in spite of every attention to it, a spiked roller, of such dimensions as to work between the rows, will effectually loosen the soil, so that hoes and grubbers may follow without inconvenience. We give on the following page a drawing of such an instrument, which has been found very effective.

The cylinder may be used with or without the spikes, or may be removed entirely; the instrument then becomes a scarifier or grubber, according to the shape of the coulters which are fixed to it. The front wheel is of use to move the whole instrument upon, by lifting the stilts or handles in the manner of a wheelbarrow, at the end of the rows, when the horse turns out of one row into another. The cross bar on the frame before the roller is to fix hoes or coulters on, when the roller is taken away.

When the beans have pushed their stems, and the proper leaves appear above the seed leaves, the intervals should be carefully hoed, and, where it is practicable, three or four bushels of gypsum per acre may be sown, if the soil does not already contain this substance, and it will greatly stimulate the growth. The mode of its operation is not exactly known, but experience has proved its utility. [See Manure and Gypsum.] A very small quantity of gypsum seems to stimulate the growth of all leguminous plants and clovers, but if this quantity be already present in the soil no additional quantity seems to have any effect. It has been recommended to cut off the tops of the plants when the lower pods are set, as is frequently done in garden culture, to accelerate the filling of them, and to prevent useless blossoms from drawing the nourishment to the top. The reason for doing this in gardens is, that when a plant has



[Roller with Spikes.]

borne pods a certain time it is most advantageous to remove it, and the top blossoms, of course, never come to perfection. In the field this is not the case, there being no succession of plants; and, unless the top blossoms are very late, or the black dolphin (aphis) begins to appear, which is shown by the honey-dew on the top shoots, no advantage is gained by topping the plants, and the labour is thrown away. When the leaves of the beans begin to lose their green colour, and the pods to turn black, the crop should be reaped with the sickle, and made into small sheaves, tied with straw bands or tar twine, and set up in the field to dry. In some places peas are sown mixed with the beans, or the headlands are sown with peas, the halm of which is used to tie the beans with; but pease cling round the bean stalks and impede the setting of the pods; they also interfere with the hoeing and weeding, so that the practice is not to be recommended. Peas require a lighter soil and are best sown separately, except when they are sown broad-cast mixed with beans, in order to be mown in a green state as fodder for cattle or for pigs. Sowing beans for this last-mentioned purpose is not much practised in England, but is found very useful on the Continent, especially in Flanders: in this case they are mown like tares soon after the pods are formed. In order to have a succession of this green food, they should be sown at different times, with a week or fortnight's interval. By this means a great deal of grass is saved, which may be reserved for hay; the cattle fed in the stables or yards thrive well on this food, and produce a quantity of rich manure, chiefly in a liquid state, which fills the tanks and reservoirs which we have repeatedly mentioned as indispensable appendages to every good farm-yard. By having winter tares when the turnips are consumed, pease and beans after the first crop of clover, and summer tares to succeed them, cattle may be fed in the stables all the year round with great advantage, the land may be tilled at the best season of the year, and prepared for wheat, as well as by a clean fallow, while the green crop will fully repay all the expenses. Three bushels of beans and two of peas mixed together are required per acre when sown broad-cast, or drilled in each furrow after the plough. It is often advantageous to cut in a green state those beans which were sown for a general crop, when food for pigs is scarce. They will go nearly as far in this way in feeding store pigs as the beans would have done when ripe, and the ground is left in a much better state for the following crop.

Although beans grow best in a rather heavy soil, they are often profitable on much lighter land, especially after clover ley or grass, which is broken up after being depastured two or three years. This is an excellent preparatory crop for wheat, and better than oats, which leave such land full of weeds. In this case the land should be carefully ploughed up. For this purpose a skim-coulter, which has a small wing attached to it, to slice off the grassy surface of the land and turn it under the furrow, is a most useful appendage to the plough. This makes very clean work, and a heavy roller drawn across the stitches or lands leaves the whole surface compact and solid, keeping the moisture from evaporating and facilitating the slow decomposition of the roots of the grass. Thus a very good and clean crop of beans may be obtained. If the soil should be exhausted or very poor, a good coat of manure spread over the grass and ploughed in will be a great advantage to the beans, and to the wheat which is to follow. On moderately light loams the most profitable rotation of crops is that of turnips, barley, clover, beans, wheat; or, if it is in a rich state, turnips, barley, clover, oats, beans, wheat, beans. When land is in good heart beans are often added to any rotation after wheat or before it, and the fallow is thus removed a year farther on. This is likewise done when it is intended to change the course of crops: because beans are considered the least exhausting of the crops which are allowed to ripen their seeds, and this practice is far less hurtful than the too common one of taking another crop of oats after the wheat, by which more harm is done than the value of the crop can compensate for.

The diseases to which beans are subject

are, the mildew, which is a minute fungus that grows on the stems of leaves, and is caused by cold fogs and frequent sudden variations of weather, and the black dolphin, an insect of the aphis tribe, which appears first in the form of a honey-dew on the tops of the plants. For the mildew no remedy or preventive has yet been found. Whenever it has attacked the plants generally, before the pods are filled, the best method is to cut down the crop in its green state; and if it cannot be consumed in the farm-yard, to plough it into the ground, where it will decay rapidly, and be an excellent manuring for the succeeding crop of wheat. If allowed to stand, the crop will not only be unproductive, but the weeds will infest the ground, and spoil the wheat crop by their seeds and roots, which will remain in the soil. Whenever the tops of the beans begin to be moist and clammy to the feel, it is the forerunner of the aphis. They should then be immediately cut off, and this, if done in time, may save the crop from the ravages of the insects; but the most effectual way to prevent any disease from attacking the plants in their growth is to have the ground in good heart, and well tilled; to drill the beans at a sufficient distance between the rows to allow of the use of the horse-hoe, and thus to accelerate the growth of the plants, and enable them to outgrow the effect of incipient disease, which seldom attacks any but weak plants.

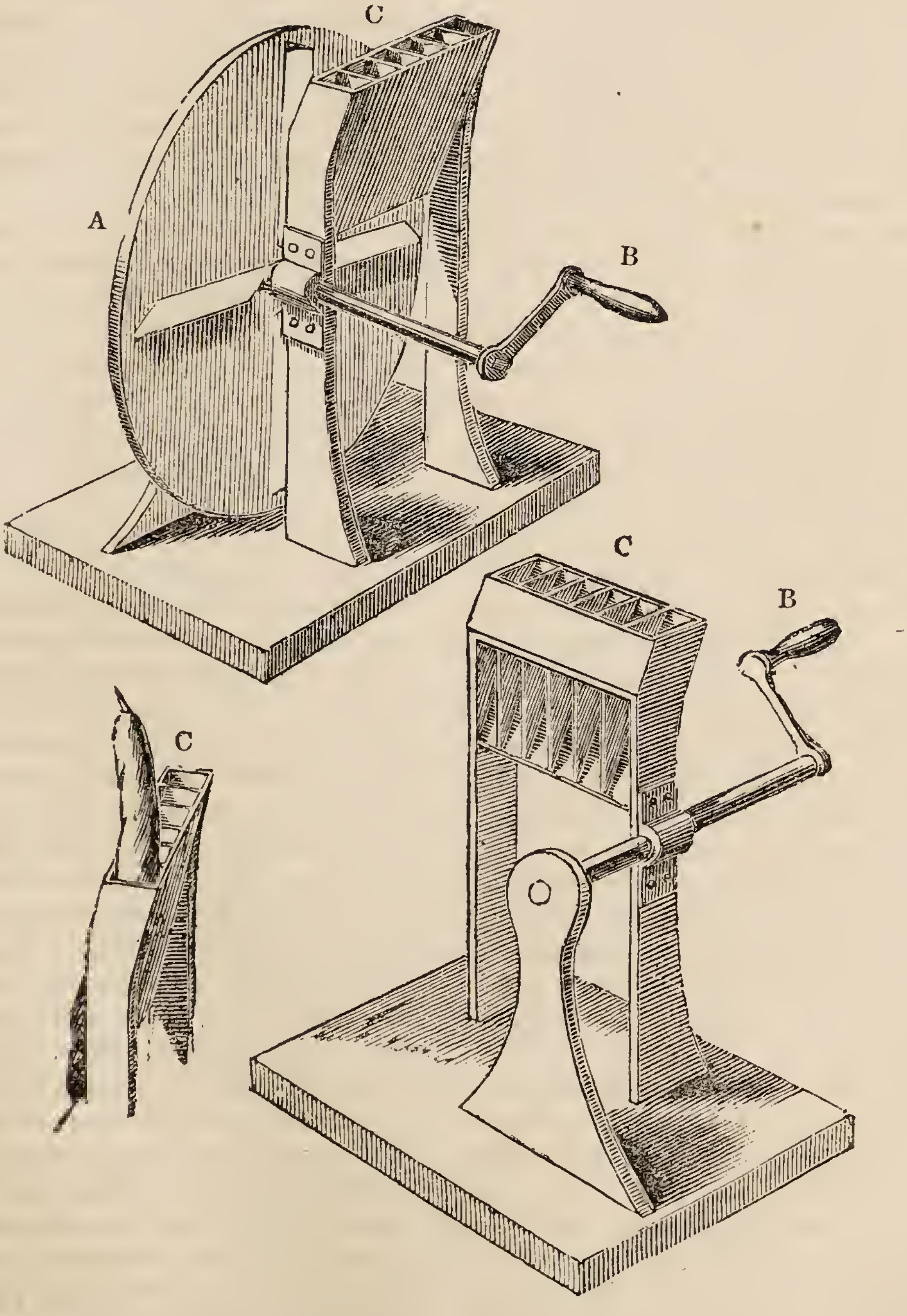
The principal use of beans is to feed horses, for which purpose they are admirably adapted, and far more nourishing than oats. They should be bruised or split in a mill, and given to horses mixed with hay and straw cut into chaff; this will insure proper mastication and prevent that thickening of the wind, as it is called, caused by indigestion, which makes beans alone not so well adapted for the food of hunters and racehorses. Great quantities of beans are consumed in fatting hogs, to whom they are given whole at first, and afterwards ground into meal. Bacon hogs may be fatted entirely on beans and bean-meal; but as this food makes the flesh very firm, it is not so well adapted for delicate porkers. In the last period of their fatting, therefore, barley-meal is usually substituted for bean-meal. Bean-meal given to oxen soon makes them fat, and the meat is far better than when oil-cake is used for that purpose: mixed with water and given as a drink to cows it greatly increases their milk. A small quantity of beans is generally mixed with new wheat when ground to flour: the millers pretend that soft wheat will not grind well without beans, and they generally contrive that there shall be no deficiency in the necessary proportion. Thus a quantity of beans is converted into what is considered as wheaten flour. This practice is well known to all bakers and dealers in flour; and as there are means of discovering the quantity of bean-meal in the flour, the ignorant and unsuspecting only are deceived, and the price of the flour to the skilful purchaser varies according to the quality.

The proportion of nutritive matter in beans, compared with other grain, is, according to Einhof, as follows:—

	By weight.		Or in a bushel.
Wheat . .	74	per cent.	about 47 lb.
Rye . . .	70	„	„ 39
Barley . .	65	„	„ 33
Oats . . .	58	„	„ 23
Beans . .	68	„	„ 45
Peas . . .	75	„	„ 49
French beans	84	„	„ 54

The French bean, kidney bean, or haricot bean (*Phaseolus vulgaris*), is chiefly cultivated for its tender and succulent pod, being one of the most esteemed vegetables for the table. The varieties are innumerable, differing slightly in their qualities: they may be divided into two distinct kinds, the dwarf and climbing; the former are the earlier, the latter the more productive. French beans are much less hardy than the common beans; a very slight degree of frost will destroy them entirely. The early sorts are therefore sown in sheltered situations, and occasionally protected by glass frames or mats. The climbing beans require the support of sticks or wires, round which they twine as they grow, with this peculiarity, that the coils turn round the support from the right to the left, contrary to the growth of some indigenous twisting plants, which turn from the left to the right, following the apparent diurnal motion of the sun.

The French bean, as an esculent vegetable, is wholesome and nutritious in a fresh state, and may be readily preserved for winter store or sea voyages by salting in casks. For this purpose the large, flat-podded, Dutch white runner is preferred. In Holland and Germany, where large quantities are salted in almost every family, a machine is used for cutting them expeditiously, which greatly resembles a turnip slicer, and may, with a slight alteration, be used also for slicing cabbages when making the national German preparation of sour krout (*sauer-kraut*). It consists of a wheel or disk, A, in which two or four knives are set at a small angle with the plane of it, so as to shave off a thin slice obliquely from the beans, which are held in a box, C, with several partitions in which they are kept upright, so as to slide down in proportion as they are cut: thus six or eight beans are sliced at once, and very rapidly, merely by turning the handle B, and supplying the box with beans in succession. The sliced beans fall on the table below, and are immediately put in a cask with alternate layers of salt. When the cask is full and



[Bean Cutter.]

well pressed down, a round board is put over the beans and a heavy weight upon it. As the beans are compressed, and begin slightly to ferment, the liquor is poured off, some fresh salt is strewed over the surface, and a linen cloth is pressed close upon it to keep out the air; the round board and weight are put over the cloth, and so the beans remain till wanted for use. When any are taken out they are washed in soft water to take out the salt, and gently stewed with a little gravy, or with milk and a piece of butter. They form a very wholesome vegetable dish at a time when fresh vegetables are scarce. The dried seeds are also boiled after being soaked in water for some time, and are usually mixed with the preserved green beans in the same dish. This use of the French bean is not common in England, but when we take into consideration that they are extremely wholesome and nutritive, much more so than peas, and that they are an admirable corrective of the oily qualities of animal fat by their farinaceous qualities, we shall regret that both the culture and the use of them in the dry state are not extended for the benefit of the labouring part of the community. The cultivation of the French bean for the seed is confined in this country to the gardens and nurseries, and to a few spots in the Isle of Thanet in Kent, where they are raised for the London seedsmen. This is the only place, as far as our observation goes, where they are sown in the field. The produce in seed is said not to exceed twenty bushels per acre, but it must be observed that it is chiefly the dwarf sorts which are sown. There is no doubt that the produce of the runners would greatly exceed this quantity, and although it might be expensive to support them with sticks, the example of the hop-grounds proves that, where the return is large, no expense or trouble is spared.

The best soil for French beans is a rich mellow loam, rather light than otherwise; but, provided the ground be well stirred, they will grow in any soil. They may be planted in rows, the dwarf sorts at two and a half or three feet distance; the runners at four feet. As soon as the stems begin to rise above the seed leaves, the intervals should be well hoed with the horse-hoe, and the rows by hand. The scarifier or grubber may be used to loosen the soil, and when they are somewhat advanced in growth the runners may have sticks to climb upon. A row of turnips may be sown between every two rows of beans; or cabbages may be planted for cattle. The crop may be harvested as soon as the lower pods are quite dry and the seeds hard, and threshed like other beans. The seeds when raw have a bitter taste, and are rather tough under the teeth, which makes animals refuse to eat them in that state, but when boiled they become soft and pleasant. Oxen and pigs eat them readily. They contain, according to Einhof, 84 per cent. of nutritive matter, of which 50 is pure farina, the rest gluten and mucilage: they are, consequently, superior to every other grain or pulse cultivated, in point of nourishment; and when it is taken into the account that they remain in the ground only from May to September, and that a crop of cabbages or turnips is growing in the intervals at the same time, it will appear that the cultivation of this pulse on a large scale might add greatly to the resources of agriculture.

BEDFORDSHIRE AGRICULTURE. —The climate of Bedfordshire, partaking of that of the interior of England, is not so wet as the western coast, nor so much exposed to cold winds as the eastern maritime counties. The air in general is mild and healthy, somewhat keen on the chalky hills, and moister on the cold wet clays. The surface of the county is much varied; but none of the hills rise high or abruptly, with the exception of the chalky ridge, which is a continuation of the Chiltern Hills, and which appears high only by comparison with more gentle undulations. Many of the slopes of the hills are skirted with woods and coppice, which add much to the general appearance of the country when viewed from an eminence. The soil varies greatly. On entering the county from the south the soil is composed of chalk, covered with a very thin layer of earth, which is consequently nearly in a state of nature, and only fit for sheep-walks. On descending the hills there occurs a mixture of chalk and clay, known by the name of "white land," which is stiff, but tolerably fertile. Various kinds of loam, chiefly clay, succeed, till you arrive at a sandy belt which stretches obliquely across the county from Leighton Buzzard to Biggleswade and Potton on the borders of Cambridgeshire. Along this belt runs the river Ivel, which falls into the Ouse at Tempsford. Between the course of the Ivel and the valley of the Ouse near Bedford lies a tract of stiff soil of various texture and quality, but quite different from the light soils found in the belt. Along the course of the Ouse, especially near Bedford, a gravelly soil prevails, covered in some places with a layer of rich, brown earth, well adapted for every kind of agricultural produce. Proceeding north of Bedford the general character of the soil is stiff, wet, and poor, with very few exceptions. The most fertile spots in the county are in the brown earth before-mentioned in the valley of the Ouse near Bedford, and in the sandy belt, where the soil washed down from the hills has accumulated, in particular basins, on a porous substratum. These soils, composed of rich loam and of great depth, are admirably adapted for market-gardens, for which the county has long been noted. The parish of Sandy in particular, not far from Biggleswade, and some others, produce an abundance of vegetables, not only for the supply of the neighbourhood, but also for distant markets. At the same time there are spots, both in the chalky hills and in the sandy eminences, which are as barren and unproductive as any in England; especially where a grey loose sand abounds, on which nothing but ling or heath will grow. These are scarcely of any use but as rabbit warrens, although some of them have been brought into cultivation. Along the river Ivel, in the parishes of Tingrith, Fletwick, Westoning, Hitton, Maulden, &c., a considerable quantity of ferruginous peat is found.

From this brief sketch it will be seen that there is scarcely any county of which the soil is so diversified, and where experiments on the best mode of cultivating various soils could be made with more advantage. With the well-known patronage of the Dukes of Bedford, especially of the late Duke Francis, and other large proprietors, and the example of their stewards and immediate tenants, one would expect a greater progress in the science and practice of agriculture than will be found in the county in general on careful examination. Many improvements have, no doubt, been introduced since the county has been more generally inclosed, which could not be expected while the system of common fields precluded any deviation from the established rotations of crops; but much yet remains to be done before the county of Bedford can vie with the eastern maritime counties, from the Thames to the Humber, in the cultivation of the land, or in the management of stock. The poor cold clays, which form a considerable portion of the soil of this county, as they are cultivated at present, give no great return to the farmer. The chief produce is corn, and it requires much labour and expense to obtain a very moderate crop. This, together with the gradual depreciation in the value of corn when compared with stock, makes the rents very low. Most of the land north of Bedford does not let for above 10*s.* an acre, and some as low as 6*s.*, in spite of considerable expense incurred by proprietors in fencing and making ditches, an essential improvement on this kind of soil. That a better system could be adopted there can be no doubt, but old prejudices interfere with the better management of cold wet clays; and while poor light soils, formerly considered as nearly barren, have been greatly improved by the introduction of turnips and the profit on sheep, the poor clays are still managed nearly in the same manner as they were a century ago; and many practical and intelligent men imagine, that no new method can be adopted with any chance of success. The chief cause of this is, perhaps, the difficulty of converting such soils into good pasture after having been once broken up; but this difficulty, however real, is not insurmountable.

On this subject we must refer the reader to the article GRASS-LAND, in which the principles of this important part of agriculture will be discussed. In the account of the agriculture of BERWICKSHIRE, also, some useful practical examples are given.

It must be acknowledged by all those who are interested in the letting of land, that there is a great difficulty at present in finding responsible tenants, with sufficient capital, who are inclined to take a farm consisting chiefly of heavy and cold arable land, however low the rent may be; and that, when a tenant is tempted by a very reduced rent to take such a farm, he is soon discouraged and repents of his bargain: whereas light lands, however poor, upon which turnips can be made to grow, and sheep can be kept, soon find respectable tenants.

In the light lands the system is well established, and nothing is required but to follow the regular course of crops, and pay some attention to the sheep; the crops are less precarious, and the weather does not so often interfere with the common operations of husbandry. Hence it is that the chief improvements have been made in the sandy soils; and it will require some new impulse to agricultural speculations to engage either proprietors or tenants to adopt an improved system on the wet clays. But, even according to the old system of fallowing and cropping, the clay soils in Bedfordshire are not cultivated in the most approved manner, as will be seen by comparing the usual operations with those on similar soils in Essex and Suffolk. The old method in Bedfordshire, which is still continued by many farmers, was to fallow the land every third year, and as by this system there was no means of raising a sufficient quantity of manure to dress the land fallowed, recourse was had to the folding of sheep. This system was well adapted to situations where ample commons gave the means of keeping the sheep at a small expense; but where such commons have been inclosed, and the sheep must necessarily be maintained on the farm, it is evident that, unless food for the sheep be raised on the field on which they are folded, one part of the farm is robbed to enrich the other; and the damage done to the sheep by folding them on cold, wet clays in rainy weather, is probably not compensated by the good which their manure does to the following crop. The manner, also, in which the fallows are treated is not perfect. The old custom was to give only three ploughings, which had distinct names: the first was called the *fallow*, the second *stirring*, and the third *laying up*. There seems to have been a prejudice against frequent ploughing of stiff soil, and the drag or harrows were not much used. This is very different from the practice on stiff soils in the county of Essex, where they never think they can plough enough. (See Bachelor's *Survey of Bedfordshire*, p. 329.)

The usual rotation was, first a fallow, of which as much as could be folded over with sheep was sown with wheat; the remainder was slightly manured, and sown with barley. The second crop was beans or oats; and then the land was so foul and exhausted as to require another summer fallow. Better rotations have been introduced since the common fields have been divided and inclosed; but the old and faulty system, under which the ancestors of the present race lived comfortably, and at low rents, is looked back to by many as superior to those which have been introduced since. The great fault lies in the want of balance between the land tilled for corn, and that which is devoted to grass or green crops for cattle. Some farms are managed in a scientific manner, but the example has not been very generally followed.

There are a few meadows along the course of the rivers Ivel and Ouse which are occasionally flooded. Where the subsoil is gravelly and porous, the herbage is good and abundant; where it is composed of clay, and there is not a very ready channel for the water to run off, the herbage is coarse and full of rushes. These meadows might be much improved by banks and sluices judiciously placed. In no other part of the county is there much good grass-land, a few spots near the larger towns excepted. It has been urged, as a reproach to the soil of the county, that there was no pasture in it that would fatten a bullock. Whether this be correct or not, it is certain that no such rich grass is to be found, as may be seen in some of the richer grazing districts.

There is nothing remarkable in the cattle and sheep in this county, there being no indigenous breeds of either. The cows are of every imaginable breed; and as there are few extensive dairies, except some about Ampthill, no particular breed is kept so pure as to deserve a name. Some few individuals have taken pains to introduce choice cattle, but these are exceptions; and, in general, the few oxen that are fatted are bought of drovers at the different fairs, and are chiefly Scots, Welsh, and short-horns. The sheep are mostly Leicesters and South-downs, which have nearly superseded the old horned breed formerly kept: for although these were more hardy, and suffered less from folding on cold wet land, the improved breeds are much more profitable, especially in inclosed fields.

Formerly there were many rabbit-warrens on the poor light grey sands, as this was considered the only means of deriving any profit from so poor a soil. Most of these have been converted into farms, whether with much advantage in general we will not say, but in some cases with a decided improvement; and rabbits are now considered more as a nuisance to the adjoining lands, than as a source of profit. An attempt was made lately to breed tame rabbits, and to fatten them for the London markets, with food raised purposely for them. Many thousands were kept on this plan by Mr. Fisher, in buildings raised on purpose near Ampthill, but the speculation did not answer, and the establishment was broken up. Whether this species of industry might not be profitable to cottagers on a small scale is a subject worthy of experiment. The chief thing to be attended to in feeding rabbits is cleanliness and air; and from their prolific nature, and the value of the skin and flesh of the best sorts, it is highly probable that, with good management, a considerable profit might be made from them. The pigs reared and fatted in Bedfordshire are mostly of the Berkshire and Suffolk breeds, but no great pains are taken to keep up their distinguishing qualities, and they are often crossed very injudiciously. No animal varies more in its qualities than the pig, and the different breeds have only one point in common, that of being prolific. The qualities of fattening early, and on a small quantity of food, belong only to very improved breeds, which are not kept sufficiently distinct in this county.

The farms in Bedfordshire are not in general of great extent. Some few contain from 500 to 600 acres, but the average size is under 200. Leases for long terms are not common, which is an obstacle to improvement. Farms held from year to year may be kept in good heart, and well cultivated, on the common established system, provided there be a just confidence in the honour of the landlord, that he will not suddenly or capriciously remove a tenant; but no great and permanent improvements can be expected to be made, except by a proprietor or a lessee for a considerable term. A tenant liable to be ejected at a short notice cannot obtain credit to borrow money to lay out on his farm; and if he is prudent, will not lay out his own capital on an uncertainty. Formerly there were many small proprietors and yeomen occupying their own lands to the amount of from twenty to fifty acres, but they are mostly reduced to the state of cottagers and labourers. A very few have had the good fortune to take advantage of the high prices, and to sell their farms to the surrounding larger proprietors; but many, by increasing their occupations, which required additional capital, have been led to mortgage their land, and have gradually been involved, till they were obliged to sell their little property to pay the mortgage. Thus a class in society, between the cottager and the large farmer, has nearly disappeared.

An agricultural society was established at Bedford in 1803, under the patronage of the Duke of Bedford, which has done some good, and distributed rewards and prizes, both for improvements in agriculture, and to encourage industry; but the true stimulus to improvement is profit, and of late years this has been entirely wanting. The disheartened farmer has no spirit to try experiments, which require some outlay, without a rational prospect of an adequate return: and the example of rich proprietors is seldom followed, until the real profit is well ascertained, which it is often very difficult to do.

BEET, a plant of the genus *Beta*, in the class *Pentandria*, and order *Digynia* of Linnæus, and, in the natural order, *Chenopodeæ* of Jussieu.

There are two distinct species of beet commonly cultivated, each containing several varieties, the one called *Beta Cicla*, or *Hortensis*, producing succulent leaves only, the other the *Beta Vulgaris*, distinguished by its large root. The cicla is chiefly cultivated in gardens as a culinary vegetable, and forms one of the principal vegetables used by agricultural labourers and small occupiers of land in many parts of Germany, France, and Switzerland. A variety known by the name of Swiss *chard* produces numerous large succulent leaves, which have a very solid rib running along the middle. The leafy part being stripped off and boiled, is used as a substitute for greens and spinach, and the rib and stalk are dressed like asparagus or scorzenera; they have a pleasant sweet taste, and are more wholesome than the cabbage tribe. In a good soil the produce is very abundant, and if cultivated on a large scale in the field, this species of beet would prove a valuable addition to the plants raised for cattle. By cultivating it in rows, and frequently hoeing and stirring the intervals, it would be an excellent substitute for a fallow on good light loams.

All cattle are very fond of the leaves of this beet, which add much to the milk of cows without giving it that bad taste which is unavoidable when they are fed with turnips or cabbages, and which is chiefly owing to the greater rapidity with which the latter undergo the putrefactive fermentation. If sown in May in drills two feet wide, and thinned out to the distance of a foot from plant to plant in the rows, they will produce an abundance of leaves, which may be gathered in August and September, and will grow again rapidly, provided a bunch of the centre leaves be left on each plant. They do not sensibly exhaust the soil. These leaves, when boiled or steamed with bran, cut chaff, or refuse grain, are an excellent food for pigs, or bullocks put up to fatten.

The second species, the *Beta Vulgaris*, or beet-root, has been long cultivated in gardens; especially that variety called the red beet, which, when boiled and sliced, makes such an excellent addition to winter salad. It is a native of the south of Europe, and hence all the varieties are tender, and destroyed by frost when in their young state. It thrives best in a rich, light, dry soil, and, from the length of its tap-root, requires a considerable depth. The white beet is an excellent root, and is preferred by many to the larger and more common intermediate varieties. It has been lately in great repute in France and Belgium for the manufacture of sugar. It is not commonly cultivated in our gardens, and we only notice it as being, with the red beet, the parent of those varieties which have been introduced into field culture.

The common field-beet for cattle, which has been long known in Germany, was introduced into England at the latter end of the last century; and its introduction is generally attributed to the late Dr. Lettsom, a physician of great reputation, and one of the Society of Friends. The German name is *mangold wurzel* or *mangold* root, but it is commonly pronounced *mangel wurzel*, which means *scarcity* root; and by a strange translation it is called in French *racine d'abondance*, or root of plenty, as well as *racine de disette*, or root of scarcity. The name of *field-beet* is much more appropriate.

The improved variety of this beet, which grows to a very large size in good soil, has a red skin, and when cut through appears veined with red, in concentric circles. The principal part of the root rises often a foot and more above the ground, and the leaves, which are large and succulent, spring from the crown of the root. There is a limit, however, beyond which the root does not improve in quality as it increases, and the roots of a moderate size contain more saccharine and nutritive matter in the same bulk than the larger. This is particularly the case with those varieties from which sugar is extracted. The soil best adapted for the beet-root is a deep sandy loam, naturally rich, or made so by repeated manuring. The manure should be well incorporated with the soil, and if any is added for this crop, it should be well rotted and ploughed in deep. The application of liquid manure during the growth of the plant greatly increases the roots; but it is also said to make them more watery, and for the sugar beet it is not recommended. The seed, which should be chosen from the most perfect plants, is sown in May: if sown sooner, there is some danger from the frosty nights which often occur about the beginning of that month; or if the spring is warm and genial, it gets too forward, and instead of increasing in the root, it shoots up a seed-stalk, and the root becomes comparatively useless. If it is sown later than May, it never arrives at a full size before the approach of winter: hence the first or second week in May is the best time in our climate. It is found by experience that those plants of beet which grow from seed sown where they are to remain have larger roots, in general, than those which are transplanted; the seed is therefore usually drilled, or dibbled, in rows from twenty-four to thirty inches distant; the seeds are put in about an inch deep, and when they are dibbled, the holes are about four inches asunder, and two or three seeds are put in a hole. After they come up and are out of danger of frost or insects, they are thinned out, so as to leave the plants a foot asunder. Where the plants have failed, the intervals are filled up by transplanting some of those which are superfluous in other parts: in doing this it is essential that the fibres of the roots be not torn off in pulling up the plant; and if they are taken up carefully with some of the mould adhering to the roots, it will well repay the additional trouble. If the ground is well prepared, there is little fear of the plants not coming up, or of their being destroyed by the fly, as is too often the case with turnips. A sprinkling of liquid manure along the rows, about the time that the plants first appear above ground, will in general secure an abundance of them; and this may be done with much less trouble than would be imagined, by those who have never practised it. It requires only a water-cart, with a large cask and two leathern hose, kept at a proper distance from each other by a stick between them, so that they may pour the liquid manure over two rows at once. If the field be not above a mile from the tank, a man and horse will water two acres in a day, and if the distance is half a mile, four acres; the expense will be amply repaid in the crop.*

On a very large scale this may not be so practicable; but wherever a field of beet is near the home-stall, it should never be omitted; the evident advantage of it will soon remove any objection arising from trouble or expense. When the plants are three inches above ground, they may be thinned out a foot apart in the rows; the intervals between the rows may be stirred with the plough, grubber, or horse-hoe, and the intervals from plant to plant in the row with the hand-hoe. The ground cannot be kept too fine and open, provided the soil be not extremely porous, and the weather very dry; in that case it must not be stirred so much, for fear of the moisture evaporating too much. It is a common practice to throw the earth from the rows against the roots; but the most experienced cultivators do not approve the method: on the contrary, they recommend drawing the earth from the plants, or at least laying the whole ground level. Where the soil is naturally rich and deep, the drills may be made on the level ground; but if the soil is shallow, or the subsoil of a barren nature, it is best to raise small ridges, as is done for turnips on the Northumberland plan, and bury the dung under them, by which means the roots have more room to strike downwards. As soon as the outer leaves begin to droop, they may be gathered and given to cattle, but a tuft should be left in the centre to carry on the vegetation, or else the roots will not increase. This practice of gathering the leaves is strongly recommended by some, and they assert that the root does not suffer in the least, although the leaves are reproduced; but here we would give this caution, founded on experience and observation. The drooping leaves, if not gathered, will decay and fall off; they have performed their office, and therefore to gather them before they wither is a real economy: but to strip off fresh and growing leaves must injure the plant, and the juices required to replace them are so much taken from the growth of the roots. When fodder is very scarce this may be a sacrifice worth making, but if the object is to reserve the roots for winter food, the leaves should remain on the plant as long as they look fresh and growing, until near the time of taking up the whole crop: the top may then be cut off an inch above the crown of the root, and will be excellent food for the cows and pigs.

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* If the water-cart contains 100 gallons, it will water one-third of an acre, in rows at three feet distance; the horse will go over one mile and a half in an ordinary shaped field to water an acre, to which must be added twice the distance from the tank, taken three times. This makes in all 1½+6, or 7½ miles for each acre, when the distance is one mile.

The roots are generally taken up and stored for winter, some time before there is any danger of considerable frost; the top having been removed, and the tap-root cut off, the mould which may adhere to the fibres is scraped off with the back of the knife. The roots are then either stacked in a barn or root-house, with alternate layers of straw, and the sides and top protected from the frost by straw placed all round, in which way they will keep well and fresh till spring: or they are placed in trenches two feet deep and six feet wide, with a layer of straw at the bottom and against the sides; they are heaped up in these trenches to the height of three feet above the ground, forming a ridge at top, and then covered all over with straw, over which the earth taken out of the trench is spread, and made smooth, sloping like the roof of a house. A small trench is dug all round this heap, with a proper outlet to prevent any water from soaking in; the heaps are made of any length, according to the quantity of roots to be stored, and the two ends are secured with straw, and covered with earth like the sides. When it is required to take out the roots for use, an opening is made at the end, a sufficient quantity is taken out, and the end is secured again with straw and earth as before. When the roots have been put in dry, and some time has been allowed for a slight fermentation, and the steam produced has been allowed to escape before the heap was finally covered in, they will come out quite fresh and juicy till late in spring; but if the proper precautions are neglected, they will often rot or become musty, and then the cattle will not readily eat them. There are few crops so valuable for winter food for cattle as the beet; Swedish turnips, or ruta baga, exceed them in the quantity of nourishment, weight for weight, but on good light soils the produce of the beet per acre is much greater. On old pasture ground trenched up enormous crops of mangel wurzel have been raised. When the Regent's Park was forming, a part which had been trenched was sown very thick with mangel wurzel seed, and such was the produce, that it was sold by auction, in lots, to the cow-keepers in the neighbourhood, at the rate of 80*l.* per acre.

It is said that the cows fed entirely on beet become too fat, and give less milk; but this would be no objection with the cow-keepers who unite the fattening of their cows with the milking, and like to have them ready for the butcher as soon as they are nearly dry. For bullocks they are excellent; for horses Swedish turnips are preferable. The proportional value of hay, potatoes, Swedish turnips, and beet in feeding cattle, according to Einhof, whose statements Thaer has found to agree with his experiments, is as follows:—18 tons of mangel wurzel are equal to 15 tons of ruta baga, or 7½ tons of potatoes, or 3¾ tons of good meadow hay, each quantity containing the same nourishment: but the roots may be grown upon less than an acre, whereas it will take two or three acres of good meadow-land to produce the equivalent quantity of hay; and of all these root crops the least exhausting for the land is the beet. The white beet has been chiefly cultivated for the extraction of sugar from its juice. It is smaller than the mangel wurzel, and more compact, and appears in its texture to be more like the Swedish turnip. We have given it to cattle, and are satisfied with the result; but we have not made sufficiently accurate experiments to decide which sort is the most advantageous. It will probably be found that the nature of the soil will make the scale turn in favour of the one or the other; but for the manufacture of sugar, the smaller beet, of which the roots weigh only one or two pounds, are preferred by Chaptal, who, besides being a celebrated chemist, was also a practical agriculturist, and a manufacturer of sugar from beet-root.

This manufacture sprung up in France in consequence of Bonaparte's scheme for destroying the colonial prosperity of Great Britain by excluding British colonial produce. It having been found that from the juice of the beet-root a crystallizable sugar could be obtained, he encouraged the establishment of the manufacture by every advantage which monopoly and premiums could give it. Colonial sugar was at the enormous price of four and five francs a pound, and the use of it was become so habitual, that no Frenchman could do without it. Several large manufactories of sugar from beet-root were established, some of which only served as pretexts for selling smuggled colonial sugar as the produce of their own works. Count Chaptal, however, established one on his own farm, raising the beet-root, as well as extracting the sugar. We here give a brief account of the process, taken chiefly from his own publications, especially the work entitled *La Chimie appliquée à l'Agriculture*, 2 vols. 8vo. Paris, 1829. The first operation is to clean the roots: some effect this by washing, but Chaptal prefers scraping and paring them with a knife, although by this means one-sixth part of the root is wasted, as the scrapings mixed with earth cannot be safely given to cattle, and even the pigs eat but little of it; but it adds to the manure, and is therefore not altogether lost. Six tons of beet-root are thus reduced to five, which are next to be rasped and reduced to a pulp. This is done by a machine consisting of a cylinder of tinned iron, two feet in diameter, and eighteen inches in the axis, on which it is turned by machinery. On the circumference of this cylinder are fixed, by means of screws, ninety narrow plates of iron, rising three-fourths of an inch from the surface and parallel to the axis, at equal distances all round; the outer or projecting edges of these plates are cut into teeth like a saw; a slanting box is fixed to the frame on which the axis of the cylinder turns, so that the roots may be pressed against these plates. The cylinder is made to revolve rapidly, and the roots are thus scraped, the pulp falling into a vessel, lined with lead, placed below. When two such cylinders are made to revolve 400 times in a minute by a sufficient power, whether water, wind, or horses, two and a half tons of roots are ground down in two hours. It is necessary that this operation should proceed rapidly, or else the pulp acquires a dark colour, and an incipient fermentation takes place, which greatly injures the future results. As the pulp is ground it is put into strong canvass bags, and placed under a powerful press to squeeze out the juice. The residue is stirred, and subjected to a second and third pressure, if necessary, till every particle of juice is extracted. As the liquor is pressed out, it runs into a copper, until it is two-thirds filled. The strength is ascertained by an instrument similar to the saccharometer used by brewers, called the *pèse-liqueur* of Beaumé,* which shows the specific gravity of the liquid. The fire is now lighted, and by the time the copper is full the heat should be raised to 178° of Fahrenheit's thermometer (65° of Réaumur), but no higher.

In the mean time a mixture of lime and water has been prepared by gradually pouring as much water upon 10 lb. of quick-lime as will make the mixture of the consistency of cream. This is poured into the copper when the heat is steadily at 178°, and is well mixed with the juice by stirring it. The heat is then increased till the mixture boils, when a thick and glutinous scum rises to the surface. As soon as clear bubbles rise through this scum, the fire is suddenly put out by water poured on it, or by a proper damper. The scum hardens as it cools, and the sediment being deposited the liquor becomes clear and of a light straw colour. The scum is then carefully taken off with a skimmer having holes in it, and is put into a vessel till such time as the liquor remaining in it can be pressed out. A cock is now opened about five inches above the bottom of the boiler, and all the clear liquor is drawn off. Another cock lower down lets out the remainder until it begins to appear cloudy; what still remains is afterwards boiled again with what is extracted by pressure from the scum. The clear liquor is now subjected to evaporation in another boiler which is wide and shallow. The bottom is but slightly covered with the juice at first, and it boils rapidly. As the water evaporates, fresh juice is let in. When a certain degree of inspissation or thickening has taken place, so as to show five or six degrees of strength on the *pèse-liqueur*, animal charcoal is gradually added till the liquor arrives at 20°. One hundred weight of charcoal is required for the juice of 2½ tons of beet, which is now reduced to about 400 gallons. The evaporation by boiling continues till the saccharometer marks 25°, and a regular syrup is obtained. This is now strained through a linen bag, and the liquor is kept flowing by means of steam or hot air, and assisted by pressure. In two or three hours all the clear syrup will have run through.

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* The *pèse-liqueur* of Beaumé here referred to is an hydrometer, of which 0° corresponds to 1.000, the specific gravity of pure water at 55° of Fahrenheit; and 25° to about 1·215.

There are many nice circumstances to be attended to, which can only be learned by experience, and an outline of the process is all that we undertake to give.

The syrup thus prepared is again boiled and skimmed until it is sufficiently concentrated, which is known in the following manner. The skimmer is dipped into the syrup and drawn out; some of the thick syrup which adheres to it is taken between the thumb and fore-finger and held there till the heat is reduced to that of the skin; the finger and thumb are separated, and if the syrup is of a proper strength, a thread will be drawn out, which snaps and has the transparency of horn or rather barley-sugar: this is called the *proof*. The fire is then put out and the syrup is carried to the cooler, which is a vessel capable of containing all the syrup produced by four operations or boilings. Here the sugar is to crystallize: as soon as this commences the whole is well mixed and stirred, and before it becomes too stiff, earthen moulds, of the well-known sugar-loaf shape, and of the size called *great bastards*, are filled with the crystallizing mass, of which a little at a time is poured into each. When they are full, they are carried to the coolest place on the premises. As the crystallization goes on, the crust formed on the top is repeatedly broken, and the whole is stirred till the crystals are collected in the centre; it is then allowed to go on without further disturbance. In three days it is so far advanced, that the pegs which were put into the holes at the point of the moulds may be taken out and the molasses allowed to run out. In a week this is mostly run off. White syrup is now poured on the top of the moulds, which filters through the mass and carries part of the colouring matter with it. The process that follows is exactly that in common use in refining West India sugars.

Although most of the operations are nearly the same as those by which the juice of the sugar-cane is prepared for use, much greater skill and nicety are required in rendering the juice of the beet-root crystallizable, on account of its greater rawness and the smaller quantity of sugar that it contains. But when this sugar is refined, it is impossible for the most experienced judge to distinguish it from the other, either by the taste or appearance; and from this arose the facility with which smuggled colonial sugar was sold in France, under the name of sugar from beet-root. Five tons of clean roots produce about 4½ cwt. of coarse sugar, which give about 160 lbs. of double-refined sugar, and 60 lbs. of inferior lump-sugar. The rest is molasses, from which a good spirit is distilled. The dry residue of the roots, after expressing the juice, consists chiefly of fibre and mucilage, and amounts to about one-fourth of the weight of the clean roots used. It contains all the nutritive part of the root, with the exception of 4½ per cent. of sugar, which has been extracted from the juice, the rest being water. Two pounds of this dry residue, and half a pound of good hay, are considered as sufficient food for a moderate-sized sheep for a day, and will keep it in good condition; and cattle in proportion.

As the expense of this manufacture greatly exceeds the value of the sugar produced, according to the price of colonial sugar, it is only by the artificial encouragement of a monopoly and premiums that it can ever be carried on to advantage. The process is one of mere curiosity as long as sugar from the sugar-cane can be obtained, and the import duties laid upon it are not so excessive as to amount to a prohibition; and in this case it is almost impossible to prevent its clandestine introduction.

By allowing the juice of the beet-root to undergo the vinous fermentation and by distilling it, a more profitable result will be obtained in a very good spirit. A kind of beer may also be made of it, which is said to be pleasant in warm weather and wholesome.

Another mode of making sugar from beet-root, practised in some parts of Germany, is as follows, and is said to make better sugar than the other process. The roots having been washed are sliced lengthways, strung on packthread, and hung up to dry. The object of this is to let the watery juice evaporate, and the sweet juice, being concentrated, is taken up by macerating the dry slices in water. It is managed so that all the juice shall be extracted by a very small quantity of water, which saves much of the trouble of evaporation. Professor Lampadius obtained from 110 lbs. of roots 4 lbs. of well-grained white powder-sugar, and the residium afforded 7 pints of spirit. Achard says that about a ton of roots produced 100 lbs. of raw sugar, which gave 55 lbs. of refined sugar, and 25 lbs. of treacle. This result is not very different from that of Chaptal.

BERKSHIRE AGRICULTURE.—The climate of Berkshire is one of the most healthy in England. The chalky hills in the western part of the county are remarkable for the invigorating and bracing qualities of the air. The vales being milder may perhaps suit delicate constitutions better, and having pure streams running through them, which make the air circulate and purify it, they are considered as healthy as the hills. Fevers and epidemic diseases are very rare.

The soil, as may be expected in a country of such extent and so irregular a shape, is extremely varied. The principal hills are composed of chalk; the valleys of different sorts of loam, in which clay predominates, with gravel and sand upon it rising into small elevations. Along the rivers there are alluvial deposits. The whole county seems to lie over chalk or limestone. Windsor Castle, at one extremity, stands on a solitary mass of chalk surrounded by stiff clay. This clay, in some places, has a depth of 300 feet over the chalk, as was found in boring for water near Winkfield plain. The chalk rises to the surface near Maidenhead and Marlow. The chalk, which dips so deep under Windsor Forest, appears again in Hampshire. The clay of the forest is a compact blue clay, of the same nature as that which is usually called the London clay, and in which nearly the whole bed of the Thames lies, from near Reading to the sea.

Over this clay lies the poor sand and loam impregnated with iron, known by the name of Bagshot heath land, which extends into Hampshire and Surrey; and also the richer alluvial soils in the valleys, and along the banks of the Thames and the Kennet. Under the vale of White Horse, where the richest soils occur, the chalk runs into a harder limestone of a blue colour, and a freestone or oolite, which composes the Cotswold Hills in Gloucestershire. (See Mavor's *Survey of Berkshire*, Appendix vi.)

In the vale of White Horse are some of the most fertile lands in England. The western part of the vale is chiefly covered with rich pastures, the soil being a good loam on a sound and dry subsoil. Along the bottom of the White Horse Hills lies the rich corn land, for which the vale is renowned, intermixed with gravel and sandy loams of an inferior quality, and some very stiff clays. This land is chiefly arable, and is called white land, from the admixture of finely divided calcareous earth in its composition. It has the appearance of an alluvial deposit, enriched by the finer parts of the chalk washed down from the neighbouring hills. Along the Thames is a belt of rich meadows, extending in some places only to a very short distance from the river, and no where above two miles. These meadows have not been improved by irrigation so much as they might be, and are chiefly fertilized by the winter and spring floods.

The next district in importance, in an agricultural point of view, is the vale of Kennet, extending along the river of that name, and on the south of the hills above mentioned, from Hungerford to Reading, a distance of about twenty-five miles. The soil of this vale is not so generally fertile as that of White Horse, which is called "The Vale," by way of pre-eminence; but its soil is well adapted to the growth of corn; and the inferiority in natural fertility is compensated by superior care in the cultivation. The markets of Newbury and Reading not only supply the less fertile districts and the dairy counties with corn, but likewise give employment to numerous mills, whence the grain, in the shape of flour, is sent in considerable quantities to the London market.

The soil in this vale is chiefly gravelly, covered with a layer of more or less depth of loam, some of which is of a reddish colour, and may vie in fertility with the white land in the vale of White Horse. On the south of the Kennet are some compact clays, in which oaks thrive, and where good crops of wheat and beans are raised with careful culture. South of Newbury, towards the boundary of the county, the soil becomes less productive, till it assumes the character of the brown heath, which indicates the barren ferruginous sand of Bagshot. Along the river Kennet, from Hungerford to Reading, there is a valuable tract of water-meadows, which in some places are capable of considerable improvement by a better distribution and regulation of the waters of the river. These meadows produce much herbage, which is sometimes made into hay, and at other times depastured with sheep and cattle, but the aftermath is not found so good for sheep, being apt to rot them. They are let for spring feed at thirty or forty shillings per acre, the letter having the privilege of folding the sheep at night, which is an advantage equal to 10*s.* more. This is from Lady-day to old May-day: after which they will produce a ton and a half, or two tons of hay per acre when mown, or the grass may be cut green for cart-horses, which is thought more profitable to a certain extent.

Under the meadows along part of the Kennet near Newbury, there is a species of peat, which is extensively reduced to ashes by burning, and applied as a top-dressing to clover and artificial grasses. It lies in some places only eighteen inches below the surface, and in others four or five feet. The stratum varies in thickness from one to eight or nine feet. The bottom on which it rests is a gravelly loam with an uneven surface. The true peat is of a compact nature, and is composed almost entirely of vegetable matter. In it are found the remains of trees partly decomposed, and surrounded by a tough mass of decomposed aquatic plants. This peat is dug out, with a long and narrow spade made for the purpose, in oblong pieces, which are laid to dry, and then placed in the form of a dome, and set on fire from below. As the peat begins to burn, more is added, so as to keep up a smothered fire: and in proportion as the heap increases, and the fire becomes more powerful, moister pieces are put on to prevent its breaking out. Thus a large mass of slowly burning peat is formed, which burns for a month or six weeks before the whole is properly converted into ashes. This heap is often three or four yards high, and fifteen or twenty yards in circumference. As soon as the ashes are cooled, the whole is riddled to separate the unburnt clods, and the ashes are used immediately, or stored under cover till they are wanted. The quantity usually put on an acre of young clover is fifteen or twenty bushels: the price at Newbury is fourpence a bushel.

These ashes have been analyzed by Sir H. Davy, and found to contain,

Oxide of iron . .	48
Gypsum . . .	32
Muriate and sulphate of potash	20
	100

The principal cause of their good effects on green crops and clover-leys is, most probably, the quantity of gypsum which they contain. [GYPSUM.] Between the vale of White Horse and that of the Kennet extends a district of inferior land, partly consisting of chalky hills covered with sheep-walks, and of dales of moderate fertility. The soil is principally calcareous, with variations of clay and gravel.

The chalky hills on the west side of the Thames are separated from the hills in the south-east angle of Oxfordshire by a narrow opening near Goring, through which the river flows: if this opening at any time did not exist, the country above must have had considerable lakes in it, formed by the pent-up waters of the Thames and tributary streams. This may account for the rich alluvial soils found in the vale of White Horse. On the hills which border the Thames there are extensive views over the rich vale of White Horse, and into Oxfordshire; and in general the aspect of the country from any considerable hill is that of great richness and variety. No county in England, except Middlesex and the part of Surrey nearest to London, contains so many villas and gentlemen's residences.

The eastern part of the country, or the Windsor Forest district, though less fertile, is not less inviting as to situation. The hills from Egham to Bray are covered with very fine old and young plantations, and form the picturesque scenery of Windsor Great Park. This forms a contrast with the open heath extending to Bagshot, which was divided and inclosed in the year 1813, when the forestal rights were abolished by act of parliament. These rights, if claimed to their full extent, would have been extremely burdensome, and not readily submitted to in these times. While they existed, they had a visible influence on the agriculture of the district, and greatly retarded its progress, in spite of the example of George III.

The parishes contained within the Forest of Windsor were Old Windsor, New Windsor, Winkfield, Sunninghill, Binfield, Easthampstead, Sandhurst, Finchampstead, Barkham, Wokingham, Arborfield, and Swallowfield; and parts of Clewer, Bray, and Hurst. The open uninclosed forest in all these parishes amounted to about 24,000 acres, very little of which would repay the expense of cultivation; and much of it remains now in its original state, although divided and inclosed. The allotments given to the crown, amounting to above one-fourth of the whole, have been mostly planted with trees, where they were not already in woods.

The soil in the forest district is extremely various: along the Thames, in the parishes of Old and New Windsor, Clewer, and Bray, there are excellent meadows, and some very good arable land, consisting of loam and gravel. To the south, along the hills, which extend at the distance of two or three miles from the river, the soil is a very tenacious clay, better adapted for grass than for corn. The cultivation of it as arable land is laborious and expensive, from the necessity of bringing chalk from a great distance to correct its cold nature, and neutralize the large portion of iron and saline substances which it contains. The waters found in the land-springs, and within a certain depth in this soil, are more or less impregnated with sulphates and muriates of soda and magnesia; so that in many places mineral wells have been discovered, and occasionally much frequented by invalids for their purgative qualities. Of these there are several in Windsor Great Park, St. Leonard's Hill, Winkfield Plain, where a regular pump-room has been fitted up, and in Winkfield Park; this last was formerly in some repute. Beyond these clay hills, as we go south from the river, the soil becomes lighter, and gradually changes into a poor light loam, then a sand and gravel, which diminishes in fertility till it becomes the poor thin soil of Bagshot Heath, in which the impregnation of carbonate of iron is so strong as to deposit the iron in the brooks in the form of a rusty powder.

The old inclosures in the forest were chiefly pastures. The arable land was confined to common fields, which were of very inferior value, owing to the right of pasture over them after a certain time of the year; and while the pastures let for nearly the same rent a century ago as they do now, the arable common land let for only one-fourth of its present value; but the pastures enabled the occupier to keep sheep and cattle on the extensive commons, on which was his chief reliance for profit. Since the inclosure of the forest, arable land has improved, and pastures have decreased in value.

The general state of agriculture in Berkshire is neither of the most improved kind, nor yet to be greatly found fault with. The number of rich proprietors who hold land to some extent in their own hands is considerable. They employ intelligent bailiffs, and improved modes of cultivation are readily tried by them. The most perfect machines and implements may be found on their farms, and everything new finds some person ready to give it a trial; but there are many obstacles to their general adoption. Old methods keep a certain hold of practical men, and it is very fortunate that it is so, for no new method should be generally adopted till long experience has proved its utility. The two extremes, of an obstinate adherence to a decidedly bad system, and an incautious adoption of new inventions, are equally unreasonable. The system generally adopted throughout the county by intelligent farmers is only a modification of the antient triennial rotations. The basis is a clean fallow, for which turnips are substituted on the light soils: then two or three crops of corn, with an alternation of clover, tares, or beans between them, which are considered as less exhausting. The nature of the crops and the recurrence of the fallows depend on the nature of the land, on the seasons, and also on the care with which the first fallow has been cleaned, and the crops have been weeded or hoed. It is the appearance of weeds that gives notice of the necessity of a fallow. A good rotation strictly adhered to would be better for general adoption: and a more extensive cultivation of artificial grasses would keep more live stock, and make more manure. In the rich soils of the Vale great crops of corn are frequently obtained with little trouble, and this always makes careless farmers. They know the advantage of manure, and will spare no expense to purchase it, but the real secret of agriculture is to make it at home and at the least expense, which can only be done by means of live stock, and raising food for cattle.

There are in Berkshire a great many small proprietors, or yeomen, who cultivate their own farms, consisting of forty fifty, or eighty acres. They live frugally, and the times do not much affect them; but they have no inclination to try new schemes; the old methods satisfy them, and if they can live and pay their way they are contented.

The old implements of husbandry have been much improved of late years. The heavy Berkshire plough, drawn by four or five horses in a line, has given place to the lighter Scotch and Norfolk ploughs with two horses abreast, or in very wet and stiff soils with three in a line; more are seldom used, except to break up grass land, or when the ploughing has been deferred till the ground is very hard. Improved agricultural instruments are manufactured at Newbury and at Reading. Drilling machines on the most improved principle, and on Cook's plan, are made at Hook in Hampshire, and pretty generally dispersed through Berkshire. The introduction of these and other improved instruments has been much encouraged by the example of King George III. and the late Duke of Gloucester, whose farming establishment at Rapleys, near Bagshot Park, was on the most improved principles. Drilling the seed is becoming more general than it used to be; and several professional drillmen find it a profitable employment of a small capital to purchase the most improved machines, with which they drill the seed for the smaller farmers, who cannot afford such expensive implements. The farmer finds the horses and a man to drive them, and sends the drill to its next destination when his corn is drilled. The price paid for the use of the drilling machine is from 1*s.* 6*d.* to 2*s.* per acre, with food for the drillman, who is the proprietor of the drill, or his servant. They drill about ten or twelve acres in a day, with two horses and two men. This division of labour, which is a certain sign of improvement, is only found in the best cultivated districts, as in Essex, Suffolk, and Norfolk, where there are still many small farms.

Threshing machines were common in many parts of the county, both fixed and moveable; but during the disturbances in 1831 many of them were destroyed, and the corn is now chiefly threshed by hand, there being always a superabundance of agricultural labourers.

In noticing the agriculture of Berkshire we must not pass over the two farms in Windsor Great Park, established by King George III., one on a poor sandy soil, conducted on the Norfolk system, and another on a stiff clay, called the Flemish Farm, but by no means cultivated on the Flemish model. The greatest variety of improved instruments was introduced, and many experiments were made. Both these farms were well worth the attention of agriculturists; but the circumstance of their being supported by what was thought an inexhaustible purse rendered them nearly useless as models for imitation. They continue to be cultivated, but attract little attention.

Some extremely fine cattle are bred and kept in the Home Park at Windsor, chiefly of the improved short-horned breed; and the cows which graze close to the royal residence are certainly worthy of the privileged pasture in which they range, and the majestic trees which shelter them.

The farm of his late Royal Highness the Duke of Gloucester, at Rapleys, near Bagshot Park, deserves particular notice. This farm originally consisted of about thirty acres of poor land, forming, however, a kind of oasis in the midst of brown heath which surrounded it on all sides. When the forest was inclosed, the duke purchased a large tract of heath land adjoining to this farm and Bagshot Park. He gradually extended his purchases to Swinley Park, of which he took a lease of the commissioners of woods and forests; and in the course of less than twenty years he converted a bare and barren tract of land into a productive farm, interspersed with thriving plantations. This was effected chiefly by employing the superabundant labour of the neighbouring parishes. The whole was superintended by an active native of Scotland, Mr. Burness, the duke's bailiff, who since the duke's death has been appointed bailiff to some of the Duke of Bedford's farms at Woburn. A threshing machine, moved by an artificial stream of water, on the most improved construction, was erected on the premises, with a mill to grind meal, and one to bruise bones for manure. Mr. Loudon has given a description and drawing of this machine in the Appendix to his last edition of the *Encyclopædia of Agriculture*, and asserts it to be the most complete in the kingdom.

The size of the farms in Berkshire varies considerably: in the chalky districts they are large—some containing a thousand acres; but in the richer soils they are mostly from one hundred to four hundred acres: in the forest district they are in general of small extent. Arable land lets from 10*s*., and even less, to 2*l*. per acre; the average may be about 25*s*.; upland meadows from 1*l*. to 2*l*., and along the rivers 2*l*. to 3*l*.; irrigated meadows 4*l*. to 5*l*.

Gardens.—Near Reading there are considerable garden grounds, the soil being deep and good, and the produce coming earlier to maturity than in any other part of the country. The onions, and especially the asparagus of Reading, are remarkably fine, and in great demand in the season. Orchards are not very numerous, and fewer than they were at one time, when cider was a more common beverage of the farmer. The apples which grow in the Vale, where there are some good orchards, are mostly sent to London. About Wantage are some cherry orchards, the produce of which is great in good years, but it is a very precarious crop.

Woods and Coppice.—Woods and coppice are scattered over the county, and add to the diversity, which is a beautiful feature in its landscapes as viewed from eminences. Considerable quantities of timber are annually felled, and during the war the finest trees were readily purchased for the dock-yards. The high prices then given have considerably diminished the number of old oaks, but very fine trees may still be found in some of the gentlemen's parks, and occasionally in the hedge-rows, which are still tolerably furnished with timber, of which elm forms a considerable portion. The Forest of Windsor, with the exception of the neighbourhood of the parks, had but few trees on the wastes, and these more picturesque in appearance from their age than valuable as timber. Some of the oldest oaks in Cranbourn Wood, in the parishes of Winkfield and Clewer, are mere hollow trunks, with a few picturesque branches.

The coppices in general are valuable; and where water-carriage is near, which is the case in almost every part of the county, the produce is sent to London in the shape of hoops, broomsticks, and other rough manufactures. They are usually cut every ten years, and when well managed produce from 10*l.* to 15*l.* per acre at every cutting.

Osiers.—Along the Thames, and in the low islands which are frequently covered with water, there are numerous osier beds, which are cut every year to make baskets, and are considered as a very valuable property.

Cattle.—There is no peculiar breed of cattle indigenous in Berkshire, and those generally met with are imported from Devonshire, Herefordshire, and Yorkshire. The Glamorganshire cows are in considerable repute in some districts, but the breeds are much mixed and crossed, and not always with the greatest attention or judgment. Alderney cows, which are annually imported, are very common for the supply of butter and cream in gentlemen's families. Some very good cows have been produced by crosses of Alderneys with larger breeds. Oxen are not generally used in agriculture, although a few teams are kept on some large farms, and the work of the king's Norfolk farm in Windsor Park was at one time entirely done by oxen. They are still employed in carting, rolling, and drawing timber in the park, where the sod being soft for their feet, they can work without being shod. They are worked four at a time, and only five days in the week, and in this manner stand their work well.

A considerable number of horses are bred in Berkshire, chiefly of the cart kind; and many colts are brought young from Northamptonshire, and kept for two or three years with gentle work. They are then sent to London as dray horses, and in general obtain very good prices. In this manner horses used in husbandry, instead of losing in value, are often a source of greater profit than oxen worked two or three years, and then fatted off.

No great quantity of fat cattle is sent from Berkshire to London. In the eastern part of the county a good many calves are suckled, and are found on the whole more profitable than butter or cheese, and attended with much less trouble; but the chief advantage of calves is the addition which they make to the dung of the yard, when they have a liberal allowance of straw often renewed. This also constitutes the chief profit of keeping pigs.

Pigs.—The breed of pigs in Berkshire is one of the best in England. They are not of a very large size, although many fattened at two years old weigh twenty score when killed, and some even more. The most common weight is from twelve to fifteen score: the bone is small, and they fatten at an early age and on little food—two important qualities. The true Berkshire breed is black with white spots, but some are quite white: their snouts are short, jowls thick, and their ears stand up. A mixed breed, produced by crossing the Berkshire with the Chinese and Neapolitan breeds, possesses improved qualities, although rather susceptible of cold from being nearly without hair; but they are superior to most breeds for getting rapidly fat, and keeping in excellent condition on pasture, with very little additional food. G. H. Crutchley, Esq. of Sunninghill Park, has a choice breed of this kind; and most of the cottagers' pigs in the Forest district are of a superior description. Bacon is the principal animal food of the labourers, and they are good judges of its qualities.

Sheep.—The Berkshire sheep called the *not* was a large polled sheep, with coarse wool, useful for the fold on cold clay soils, but coarse in the carcase. It is now almost superseded by an improved breed produced by crosses from the old sheep and the Leicesters, and by the South Down, which are now the favourite breeds. Some of the Cotswold sheep, crossed with the Leicester, produce a large sheep, which gets very fat, and carries a heavy fleece of long wool: some of these were lately purchased to send to Belgium to improve the sheep in that country. Merinos were introduced by George III., who had a flock from Spain, and were at first in great request on account of the fineness of their wool; but they have not proved a profitable stock, owing perhaps to want of proper management, and chiefly because they did not produce so good carcases for the butcher, which is now the chief profit of the sheep. In Saxony the wool is the principal object; and so much attention has been paid to the Spanish flocks transplanted into that country, that their wool exceeds the original Spanish wool in fineness. Before the inclosure of Windsor Forest there was a breed of small ragged-looking sheep with a light fleece of tolerably good short wool, called the heath sheep, which, when fatted at three or four years old, produced the fine-flavoured Bagshot mutton much prized by gourmands. These sheep are bred and kept in the wastes of the forest, and sent annually in large flocks into Buckinghamshire to be folded on the fallows. Not being well attended to, many of them died, and sometimes, in a wet spring, whole flocks were swept off by the rot; they cost the proprietor little, and produced in general but small profit; they may still be seen, although in diminished numbers, on the heaths of Surrey and Hampshire which are still uninclosed.

We cannot close this brief account of the Berkshire agriculture without noticing the farm at Shalburn, called Prosperous Farm, which was formerly that of the celebrated Jethro Tull. The soil is a stiff chalky clay, such as must be greatly benefited by being pulverized and stirred; and from this circumstance may be deduced Tull's system of horse-hoeing, which at one time was thought so great a discovery in agriculture as to be named, by way of pre-eminence, the 'new husbandry.' But the erroneous theory which he adopted with respect to the food of plants, and his consequent neglect of manure and change of crops, led him and his disciples into great mistakes, and ultimately caused his ruin. (See Tull, *On Horse-hoeing Husbandry.*) It is curious that although drilling, which was first introduced by Tull, is practised pretty generally in the neighbourhood, it is not so now on Prosperous Farm.

BERWICKSHIRE AGRICULTURE.—The climate of Berwickshire, from its geographical position and its proximity to the North Sea, is colder and more subject to sudden variations of temperature than the more inland and southern parts of the island. The harvest is in general three weeks later than in the counties south of the Humber; but the weather, on the whole, is drier than in the western counties of Scotland or the north-west of England,—a very great advantage in an agricultural point of view. This is ascribed to the influence of two ranges of high land, the Cheviot hills on the south, and the Lammermoor hills on the north, which are connected by a range of lower hills on the west; these boundaries embrace a considerable extent of country, and include the basin of the Tweed between them and the sea. This basin contains numerous smaller elevations and dales, comprehending the Merse or lowlands of Berwickshire, the detached northern part of the county palatine of Durham, and parts of the counties of Roxburgh and Selkirk. This tract of land shelves gradually from both sides towards the Tweed, which receives all its streams. It exhibits the most improved practical system of husbandry, by means of which the disadvantages of a northern climate have been overcome, and a soil but moderately fertile on the whole has been made to produce in perfection all the crops which were formerly confined to the more southern parts of the island. What we shall here briefly detail of the agriculture of Berwickshire must be considered as applicable to the whole district above mentioned, and also to the valleys lying between the Tweed and the Tay in Scotland, and a great part of the counties of Northumberland and Durham south of the Cheviot hills in England. We shall therefore have frequent occasion to refer to this article, when treating of the agriculture of the surrounding counties.

Berwickshire may be divided into two distinct portions, the hills and the lowlands. Some of the eminences which belong to the Lammermoor hills rise to more than 1500 feet above the level of the sea. They are consequently bleak, cold, and unproductive, except on their lower slopes, where tolerable pastures are found, in which a hardy race of sheep and cattle is reared. In the midst of the hills there are several small valleys which are capable of cultivation, and the industry and perseverance of the inhabitants have converted many apparently barren moors and bogs into tolerably productive arable land. The parts called the lowlands of Lauderdale and Cockburn's Path contain about 10,000 acres of land fit for cultivation. The remainder, to the amount of 175,000 acres, consists of high hills covered only with heath and furze, and of sheep-walks of a moderate quality. The Merse contains about 100,000 acres of land diversified by smaller hills and dales, which form a pleasant undulation of the surface, with a soil which is extremely various. The different kinds of soil, from the most compact clays and loams to the loosest sand and gravel, often occur in a very small compass, not unfrequently in the same field, if it be of any considerable extent. Most of the farms have land attached to them of every variety and quality, but on the whole the good soils prevail. There is a peculiarity in this county worth noticing, in the total absence of chalk, or of any perceptible quantity of calcareous earth in the soil. There are a few veins of limestone in the western part of the county, but in consequence of the want of coal-mines, except in the south-eastern extremity of the county, none of it is burnt into lime; so that this substance, so useful as a manure and a means of improving the soil, is brought from a considerable distance. Along the course of the Tweed, the Whiteadder, and Blackadder rivers, there are long tracts of a very fine deep and free loam lying on a substratum of gravel or clay; and throughout the valleys the good loamy soils prevail. Those which are of a heavier kind are well adapted to the growth of wheat and beans, and the lighter to that of turnips and barley or spring wheat. The following division of the soil of Berwickshire is given in the agricultural report of the county, drawn up for the board of agriculture in 1798 by Mr. John Home. And we have no reason to doubt its being tolerably correct:—

	Acres.
Deep loam on the principal rivers . . .	25,410
Clay lands in the *how* (hollow) of the Merse . .	40,380
Turnip soil in the remainder of the Merse, in Lauderdale, Westruther, Merton, Nethorn, Longformacus, and other arable parts .	119,780
Meadows, moss, and moor of Lammermoor and Lauderdale, including some arable patches . . .	99,870
	285,440

What is here termed *meadows* means coarse marshy pastures, which are sometimes mown when fodder is scarce. They differ widely from what are called meadows in England, which in Scotland go under the general name of old grass land, to distinguish them from the arable lands laid down to grass for a few years, according to the convertible system of husbandry. The old grass lands are seldom mown, but generally depastured.

This last division is now considerably diminished by the improvements made by draining and cultivation, and we shall not be far from the truth if we take off a fifth part, and add it to the preceding division; or, taking round numbers, we may reckon that there are at least 200,000 acres of productive land more or less improved and cultivated, and about 80,000 in a state of nature, including woods. This, considering the extent of high ground, gives a very favourable idea of the spirit and industry of the proprietors and farmers. The best soils are of a reddish colour, indicating the presence of oxide of iron in that state of oxidation in which it is most favourable to vegetation, and to which it is reduced when clay is burnt which contains it. In every part of the county moors occur of greater or less extent, some of which are very poor. The thin black soil of the moors is of a loose porous nature, covering a subsoil of an impervious till or barren clay. Being soon saturated with moisture, which cannot penetrate the subsoil, it becomes of the consistence of mud. When the water is at last dried by evaporation, it leaves a loose mass without coherence, which is soon converted into dust. Such a soil can never be improved with any prospect of advantage. But where the subsoil is of a more porous nature, and drains can be made to carry off the superfluous moisture, the soil may be made productive, when rendered active by the application of lime and consolidated by cultivation.

There are not many very large estates in Berwickshire, although many of its proprietors have extensive estates in adjoining counties, or elsewhere; but some estates of no great extent are very valuable, from the richness of the soil and the improved state of cultivation. Many proprietors reside on their estates, and are their own agents, which is a great advantage to their tenants, who, being in constant intercourse with their landlords, are stimulated to greater exertions, and feel more confident of being treated with fairness and liberality. The lands in the hands of the proprietors are generally cultivated in the most approved manner, which keeps up a spirit of emulation and improvement among the tenants. Several considerable landed properties have been acquired by the profits of agriculture, or have been originally derived from that source. The proprietors of these estates continue to feel an interest in the pursuit to which they owe their fortune, and are generally foremost in all agricultural improvements.

The farms in Berwickshire are generally of considerable size, from 500 to 1000 acres, or more, and tenanted by men of good capital, who pay their rents punctually, and cultivate the land in a regular and scientific manner. Leases, generally for nineteen years, are almost universal; and this may be considered as one of the chief causes of the high state of cultivation in which the land is kept, and the expensive improvements which have been made by the tenants. All the land is inclosed, or may be so at the cost of making the fences; there are no common lands or rights of common. Antiently a great part of the arable land in Scotland was divided into various narrow strips, spread over a considerable extent of ground, and separated by grass baulks, as was the case in the old common fields in England. Land lying in this manner was called *run-rig* and *run-dale*, and a most inconvenient arrangement it was, which made any considerable improvement impracticable. The origin of this division may be traced to the feudal times, when the lord of the soil parcelled out the land amongst his retainers. The most fertile spots were naturally coveted, and were divided so as to prevent any jealousy; each had a portion of what was considered the best, and also of what was inferior. These allotments being accumulated, or subdivided by purchase and by inheritance, produced that inconvenient distribution of run-rig and run-dale, consisting of long strips of a few furrows wide, up hill and down hill, parallel to each other, every slip having a different owner. When agriculture began to be more than the mere means of obtaining food, and the expenses of cultivation began to be reckoned, the necessity of collecting the dispersed portions of land became apparent. The first step to improvement was to lay them into common fields, and to adopt a regular mode of cultivation. The next advance towards a better system was a general division and enclosure of properties. For this purpose two acts of the Scottish parliament were passed in 1685 (ch. 23 and 38), which empowered proprietors to exchange their various detached lands, and collect them into large fields for the purposes of inclosure. This was done by a very simple legal process, attended with little difficulty or expense. All common rights were commuted at the same time, and every one had his land, as much as possible, collected together, and freed from all interference. Under the sanction of this law all the lands in Berwickshire, with very few exceptions, were soon divided, and a great part inclosed. They have now been so for more than a century past, so that the remembrance of the old divisions is nearly lost. There are still some common-field lands, which belong to royal corporations, and cannot be divided; the general act of inclosure excepted them by a special clause. Such is the land that belongs to the royal borough of Lauder, which is divided into 105 portions, the proprietors of which, by inheritance or purchase, were, before the passing of the Reform Bill, the only freemen and voters in the borough: so that the whole corporation might possibly be vested in a single individual who should become possessed of all the portions. Each of these portions is about two statute acres, and to the whole is attached a common pasture, or out-field of 1400 acres, of which, by common consent, a portion is regularly broken up for tillage, and divided by lot among the freemen; the remainder is common pasture, subject to a certain stint. A common herd is kept, who takes care of all the cattle, drives them out in the morning, and brings them home at night.

A considerable inconvenience, and another remnant of feudalism, remained much longer, and is scarcely yet entirely removed. This is the right of *thirlage*, as it is called, or the obligation which a tenant is under to grind at the lord's mill all the corn used in his family, and, in some cases, all the corn grown on the farm: this was originally intended merely to keep up the rent paid by the miller. Old prejudices long retarded the removal of this very impolitic restraint; and the more liberal modern landlords found that they gained more in the improved rent of their farms, by the removal of the restraint, than they ever could have done by any increased rent of the mill. The millers, without any monopoly, find that they have fully as much work as before, and the rents of the mills have kept pace with the increased rents of the land.

The farm-houses and buildings in this county, which were formerly clumsy and incommodious, or mere cottages and hovels, are now mostly of a very superior order, better adapted to the improved condition of the tenants, and the more advanced state of agriculture. The houses of the most substantial farmers are not inferior to the dwellings or *manses* of the ministers, and in many instances far superior. Perhaps the desire of giving accommodation to a superior class of tenants has led to an unnecessary extravagance in erecting some of the more modern structures. In the necessary farm buildings, especially those by which a greater quantity of live stock may be conveniently kept, it is scarcely possible to be too liberal. The farm buildings erected within the last twenty years are, in general, well planned and commodious, and have no doubt contributed to introduce substantial tenants, and an improved system of husbandry.

Labourers. — The system adopted in Berwickshire, and generally in the north of England and in Scotland with respect to labourers, is well worth the attention of their southern neighbours. The unmarried men are mostly lodged and boarded in the farm-house, the married men have cottages on the farm: the rent of the cottage is a part of their wages. The cottages are built at a small expense, generally in rows, and without upper floors. The expense of erecting one of the simplest construction is not above 20*l.*; and the fitting it with fixture cupboards and beds, which are generally boarded and closed in with doors, somewhat like the berths in a ship, will cost from 10*l.* to 15*l.* more. A table, a few chairs, a chaff bed, and a very few kitchen utensils, will set up a young labourer and his wife in his new home. They are, however, more provident in general than the labourers in the south, the poor-rates being but a slender refuge against misery; and when a young man takes his wife into the cottage provided for him, they have probably some little money between them, beyond what is merely necessary to begin to keep house with, which they have saved out of their wages. A very interesting account of the mode in which the labourer is paid in the south of Scotland appeared in the *Quarterly Journal of Agriculture*, published in December, 1834, from which, as the latest authority, we abstract what follows:—

"The terms of engagement of a married ploughman, or *hind*, as he is called in this district, are as follows: he has a a cottage and garden rent free; the run of a cow in summer; straw and three cart-loads of turnips in winter to keep her; or, instead of turnips, sixty stones of hay, as may suit his master best; the produce of 1000 yards of potatoes, measured along the drill, for which he must find seed, his master finding the dung and labour; sixty bushels of oats; six bushels of peas; eighteen bushels of barley of the best quality, after the seed has been taken out. This is given about Christmas. Formerly as much land was given as a peck of lint-seed could be sown on, but this is now generally commuted for 500 yards of potatoes in addition to the 1000 mentioned before. This is owing to the cheapness of the linen manufacture, which discourages the women from spinning flax and having it woven. In one point of view this is a loss, spinning being a good employment of spare time. Formerly poultry and sheep were kept for the labourer, but they are now generally commuted for money; 15*s.* being given yearly instead of the poultry, and 3*l.* for the sheep. Coals are driven for the ploughman, if required, which is generally a back carriage when the corn is taken to market. The whole of these allowances may be reckoned to the farmer as equivalent to a payment of 26*l.* a year, or 10*s.* weekly; but to the ploughman they are worth much more than that sum in money. The cow not only supplies the family with wholesome food, but brings money by the sale of butter and cheese. The wife, or the daughter if grown up, is bound to work for the farmer whenever she is required at 8*d.* or 10*d.* a day, especially in harvest. At this time she must work as long as it is light, as well as her husband, but then they are both fed at the farm. The manure of the cow belongs to the farmer. The garden is manured from the pig-sty, a pig being generally fed for the consumption of the family. The shepherd has, besides this, the keep of eight ewes winter and summer, which make his wages equal to 35*l.* a year. This increase is on account of the greater responsibility of his situation. The farm-steward has a similar addition in money or grain. Unmarried ploughmen living with their parents receive similar allowances, except the keep of the cow, for which they have an equivalent in money. When they are fed in the house with the domestic servants, they receive about 5*l.* half-yearly as wages. Females living in the house receive 5*l.* or 6*l.* for the summer half-year, and 2*l.* or 3*l.* for the winter. They milk the cows, attend to the dairy, and, when not so employed, work in the fields. Stable-boys have their food, and 5*l.* or 6*l.* per annum. All the farm-servants are hired by the year, the domestic servants half-yearly. There are various hiring-markets in March, which are well attended. Reapers, both men and women, get 12*s.* to 14*s.* per week and their victuals, consisting of oatmeal porridge and milk for breakfast and supper, and a pound and a half of wheaten bread and a quart of beer for dinner; they have half a pint of beer besides in the afternoon." (See *Quarterly Journal of Agriculture*, p. 380, December, 1834.)

There is a practice in Berwickshire, advantageous to all parties, of letting small portions of grass-land to cottagers, mechanics, and small tradesmen in villages, which enables them to keep a cow without being incumbered with land. They pay a high rent for the grass, but this is the whole outlay. Several proprietors of cows frequently join to hire the feed of a field. The high rent remunerates the farmer, and the milk and butter of the cow are cheaply obtained by the owner. This is a kind of division of labour which also takes place on a larger scale in the letting of turnips to breeders and jobbers of sheep, instead of the grower purchasing a flock, which he may be obliged to sell at a loss when the turnips fail. At all events the breeder and jobber are more likely to make a profit by the sheep, which is their trade, than the farmer, whose attention is taken up with the various operations on his farm.

The system of cultivation generally adopted on the arable land, is that which consists in having a great part of the land in artificial grass and green crops for a certain time, generally from two to four years, and then breaking it up for corn; by which means a much larger quantity of land may be cultivated with a given number of men and horses; the grass being chiefly fed off with the farmer's own stock, or let off to others who have more cattle or sheep than their land will maintain.

The rent of land, taking its quality into consideration, is higher than in any part of England, even if the poor-rates and tithes be added to the English rent. This is owing partly to the greater skill and capital of the farmers, and partly to the steadiness and industry of the labourers, which lessens the expense of cultivation. From 4*l.* to 5*l.* per Scotch acre, equal to 1¼ English, is not uncommon even now. Corn-rents were common at one time, and begin to be introduced again, but most of the leases granted within the last thirty years are at a fixed money rent. Personal services, and *boon* rents, that is, certain specific payments in kind to the landlord, such as poultry, butter, or cheese, are now unknown. The landlords find it more convenient to have horses and servants of their own, than to trust to the compulsory services of the tenants, which are never well performed, and are a great hinderance to the regular work of a farm. All tithes, with very trifling exceptions, were commuted above two centuries ago. There is something in the shape of a poor-rate, half of which is paid by the tenant, and half by the landlord, as well as the salary to the schoolmaster; but the amount is trifling. In 1808, according to the agricultural survey, the whole charge on the tenant amounted to no more than 2*d.* in the pound. The poor-rate has, however, increased very considerably since, but not so as to be compared to that which presses so hard upon the farmer in some parts of England.

When a tenant takes possession of his farm, the buildings are delivered to him in good repair, and he must maintain them so at his own expense, during the term of his lease. The covenants of a lease are generally very simple, and liberal as to the mode of cropping. The tenant is bound to consume all the straw on the premises, and leave what remains in the last year for his successor. In consequence of some spiteful tenants consuming the straw by burning it, in order to injure their successors, a clause prohibiting this waste has been sometimes inserted in a lease; but it is unnecessary, since an action for damages might be sustained at law, and such conduct would most likely be severely punished in the damages awarded. The in-coming tenant has usually the right to sow clover and grass-seeds, with a part of the last tenant's crop of corn; and he enters on the land intended for turnips or fallow half a year or more before the expiration of the lease. In fact, this part of the land should be given up immediately after the harvest of the last year but one, or it should be ploughed before winter for the next tenant, at a stipulated price. The out-going tenant has the use of the barn and rick-yard, for securing and threshing out his corn; and he is bound to thresh it regularly, so as to supply the cattle of the new tenant with straw, or he may be compelled to so, by application to the sheriff or his substitute.

A general clause of good husbandry is always inserted in all leases, and in case of wilful mismanagement, a jury would give adequate damages. It is sometimes stipulated that no two white straw crops shall be taken in succession, and that the turnips shall be drilled in rows. When the tenant is debarred the right of assignment, the lease becomes by the Scotch law an hereditament, and as such goes to the next male heir. Formerly, rents were paid at a long period after entry, owing to the small capital of the farmers; but now they are generally made due and paid every six months, or expected at latest within the first nine months, and from that time at the expiration of every six months.

Husbandry.—The usual system of husbandry followed in Berwickshire, as we observed before, is that which is called the convertible system, which we shall now briefly describe. It consists in laying a portion of the arable land to grass every year, and breaking up an equal quantity, which has been in grass from two to four years or more. This must not be confounded with that imperfect and slovenly practice of letting land, exhausted by repeated cropping, remain at rest as it is called, by abstaining from any cultivation, after having sown some grass and hay-seeds with the last crop, until it gradually recovers some degree of fertility by being in rough pasture for some years. The Berwickshire system consists in laying down the land to grass in a clean state, and in good heart, by sowing clover and grass-seeds with the crop of corn which immediately follows a fallow. The profit of the land when in grass is not much inferior to that which is obtained when it bears corn, and sometimes is greater, the expense being much less. Old grass-lands are not often broken up, unless it be to improve the herbage, which in some soils becomes coarse, or mixed with useless weeds. The principal object of the farmer in the convertible husbandry is to lay his arable land well down to grass, so that when he ploughs it again it is improved by having been pastured, and is in a sufficiently clean state to bear several good crops, without the intervention of a fallow. Three years in succession is the usual time that the land is in grass. It is seldom mown for hay more than once in that time, but fed off during the other two years. If the grass appears to fall off in quantity or to deteriorate in quality sooner, it is immediately ploughed up and sown with oats, of which the crop is generally abundant after grass newly broken up. Sometimes the land is immediately prepared for wheat, by repeated ploughings, which break the sods and allow the soil to consolidate by the rains. This prevents its being kept too loose and spongy by the undecayed roots of the grass, which would be very injurious to the wheat in a dry summer. In Norfolk, wheat is often dibbled on the sod of the grass merely turned over by one ploughing; or the land-presser follows the plough, and gives the necessary solidity to the bottom of the furrow for the roots of the wheat to strike in. Where either of these methods can be used to advantage, a considerable labour and expense are saved; and the land-presser, which, as far as we know, is not much used in Berwickshire, might be introduced with advantage on the light soils. The next year after the oats or wheat, turnips are sown in drills after repeated ploughings and abundant manuring. These are fed off in the course of the autumn and winter, and barley or spring wheat are sown in spring, together with white and red clover, trefoil, and grass-seeds: when the land is again converted to pasture, and continues so for two or three years as before. The deviations from the foregoing rotation are, that on the most fertile lands, where wheat is usually sown instead of oats in the first year after grass, wheat comes again after the turnips, which are fed off early in autumn, so as to have two crops of wheat, with one of turnips between them. The grass-seeds are sown in spring among the second crop of wheat. In very poor soils, oats supply the place of wheat. Beans are not very generally cultivated; but on very stiff soils, which will not bear turnips, they come in well after wheat, and may be followed by oats, and then a fallow for wheat and grass-seeds. The grass is apt to fail the second year on such very cold lands, if they are not well pulverized and completely drained; and this has introduced a variation in the cultivation of such lands, the grass being broken up after the first year. This is owing in a great measure to a want of attention to the state of the land when the grass is sown; with good management stiff lands will produce good herbage for two or three years.

In the best turnip soils, the following rotation is not uncommon:—1, Wheat on the clover ley. 2, Turnips fed off. 3, Wheat. 4, Beans. 5, Wheat. 6, Turnips. 7, Wheat with grass-seeds.

This frequent recurrence of wheat, and the intermediate beans and turnips, can only be obtained on the best description of alluvial loams; and then the land must be highly manured for the turnips in the second and sixth year, and for the beans after the wheat. This may be effected where manure can be purchased, but scarcely, in any sufficient quantity, where it is all made on the farm. The ground, however rich, must in the end be exhausted. By substituting barley in the third and seventh year, the last-mentioned rotation is like some rotations adopted in Essex and Suffolk, except the addition of the three years of grass, and may be more generally recommended for imitation. Another rotation is the following:—1, oats; 2, peas or beans; 3, barley, oats, or wheat; 4, turnips, with dung and lime; 5, wheat, oats, or barley, with grass-seeds, to be fed off three or four years. As the grass is the foundation of all these rotations, and its duration cannot always be foreseen, it is evident that great variations must occur; and it requires no little skill and ingenuity to suit the various crops to the state of the land and the seasons, and to keep horses and men regularly employed without hurry or confusion. Potatoes, tares, and other green crops for cattle, are raised on part of the fallows. The turnips are universally cultivated on the Northumberland plan, that is, in rows at two feet six inches distance; the manure is placed directly under the row by laying it in furrows, and covered with the plough by splitting the ridges. A roller prepares the ground for the drill, which deposits the seed directly over the line of the dung. [See TURNIPS and DRILL.] A part of the turnips are drawn and given to the cattle in the yards in winter, and, with the addition of straw only, keep them in good condition. The remainder is fed off with sheep on the ground, or let to breeders and jobbers for that purpose. It has long been the practice in Berwickshire and surrounding counties to depend on letting a great part of the turnips which are grown on a farm to men who rely on these lettings for their cattle and flocks in winter. In consequence of this practice, turnips have been raised without any regard to the stock on the farm, and the grower seldom fails to find customers at very fair prices. The comparative low price of corn for the last few years has induced farmers to extend the cultivation of turnips and of barley, by draining cold wet clays, which otherwise would have been unfit for these crops, of late more profitable than wheat. The use of bruised bones for manure, lately introduced, has also extended the cultivation of turnips on the sharp light lands; and, as a natural consequence, more sheep have been fattened, and the market has been overstocked, so that the speculators in fat sheep have lost considerably. Still the system has proved of advantage to the farmers and enabled them to meet their engagements with their landlords, which were entered into when wheat bore double the price it has lately done; and rents have not fallen so much as might have been expected. (*Communication from Berwickshire*, May, 1835.)

The grasses usually sown are in the following proportions:—6 lbs. of red clover, 4 lbs. of white clover, 4 lbs. of trefoil, and 3 pecks of perennial rye grass per acre. Hay is comparatively of inferior value to what it is in other counties nearer large towns, and no more is made than is absolutely required for working horses; the cows and oxen are entirely fed on turnips and straw. The grass, as well as the turnips, is often let to graziers, who from their experience in buying and selling stock, make a better profit than the farmer could, and are enabled to give a fair price for the feed. This is another example of the division of labour in agriculture, by which all parties are gainers.

There are no large dairies in Berwickshire. Butter is made for the use of the farmer's family only, except near towns, where a portion is sold in a fresh state. The markets are mostly supplied by the labourers who sell their butter, the produce of the cow kept for them by their masters, as part of their wages.

The common implements of husbandry are few, but of the best construction. Small's swing-plough, a light and improved instrument, is in general use, and no plough can be better adapted to every variety of soil. It is entirely made of iron, and is an improvement on the Rotherham plough, originally introduced from Flanders. It is almost invariably drawn by two horses abreast, except in some very wet clays, where the horses would tread the land too much, if they did not walk in the furrow. In a few cases where very heavy soils are broken up, three horses are used, either in a line, or more commonly two abreast and one before. The light swing-plough is the chief instrument of tillage: it works between the rows of turnips or beans with one horse, acting as a horse-hoe, and throwing the earth alternately from the plants and towards them. Simple horse-hoes are also in general use, as well as narrow grubbers to go between the rows and loosen the soil, and double mould-board ploughs for earthing-up potatoes: common harrows and rollers complete the assortment of instruments in general use. The old and expensive operation of weeding the growing crops by hand, which is still practised in more southern counties, is here almost entirely avoided by the care taken to clean the land for turnips, or when it is fallowed. The only weeds which require attention are docks and thistles, which will occasionally spring up in spite of every precaution.

On the whole, we may pronounce the husbandry of the counties in the north of England, and the south of Scotland, to be the most economical and profitable of any practised in the British empire, and calculated to produce the greatest rent to the landlord, with a fair profit to the farmer, and a comfortable existence to the labourer.

Cattle.—There is nothing to be particularly remarked in the cattle of Berwickshire. On the hills there is a coarse breed of black cattle, which fatten well in the richer pastures of the valleys, and produce well-flavoured meat. The short-horned oxen from Yorkshire and Durham are in repute with the larger farmers for stall-feeding. The Holderness and Ayrshire cows are preferred for the dairy and for their calves. Oxen are scarcely ever used in the plough or for draught, experience having established the superiority of horses, in spite of all the assertions and calculations of theoretical writers. Horses are more active and obedient in all kinds of work, and the decrease in the value of the animal, when old, is more than compensated by his superior usefulness while in his prime, and by the variety of uses to which he may be put. The farm horses are generally of a middle size, muscular, and active, with clean legs without much hair on them, nearer allied in shape to the coach-horse than to the heavy English cart-horse. They are mostly bred in the counties of Ayr and Lanark, in the west. Those which are bred in Berwickshire are chiefly out of picked mares, and got by stallions imported from the south or west. But the breeding of horses is not a regular branch of the rural economy of this county as it is in Yorkshire or Lincolnshire. A pair of good horses is considered sufficient for the tillage of forty or fifty acres of arable land of a moderate degree of tenacity; and as one-half of the land is always in grass, a pair of horses to every 80 or 100 acres of a farm of turnip-land is a fair proportion; provided the distance from markets and from lime be not considerable, as this makes a material difference in the carting required to be done.

The teams work ten hours a day in summer, at two yokings of five hours each, and six hours in winter, at one yoking. They plough an acre and a quarter of land on an average in a day in summer, and three-quarters of an acre in winter, which is more than is usually done in the south, if we except the light lands in Norfolk, where they frequently plough an acre and a half or more in a day. The horses are fed in summer on green food, cut fresh for them, and in winter on straw and oats. When hay is scarce, it is reserved for the time when they work hardest in spring. Each horse has usually two or three feeds of oats per day for nine months in the year: the other three months they have green clover, which is sufficient without corn.

Sheep.—There are several sorts of sheep in Berwickshire. On the hills the black-faced Tweedale sheep are most common, being strong and hardy, and able to endure the severity of the climate. They are horned, and their wool is coarse. In the Merse, and along the slopes of the hills, the improved breeds have been introduced from the south; chiefly the Leicesters, as they thrive admirably on the old pastures and artificial grasses, which the convertible system of husbandry produces in great abundance. They are well adapted to small inclosures, as they seldom roam about like the wilder breeds, provided they have sufficient food around them. The Cheviot breed of sheep, which is common in Roxburghshire, is also to be met with on the lower range of hills in Berwickshire. A very good breed has been produced by crossing the Cheviot with the Leicester. The Southdown breed of sheep has been tried by a few individuals and found to answer well; but it is not so general as the Leicester and the crossed breeds above-mentioned. Good sound grass will maintain five Leicester sheep on an acre during the six summer months, and half an acre of turnips will keep them the remainder of the year; thus the value of grass and turnips may be calculated from the improvement of the sheep, and *vice versâ.* Where so large a portion of the arable land is regularly laid down to grass, and this is chiefly fed off with sheep or cattle, it is of great importance to the farmer, that he should be able to select those animals that are best adapted to the soil and climate, and that will improve most rapidly on the food which is given them. Hence great attention is paid to the improvement of the various breeds of sheep; and rams have been selected and brought from Leicestershire and Northumberland at a great expense. A peculiar branch of rural economy has arisen from this, that of rearing rams for the sole purpose of letting them for the season. The best ewes are selected to breed from, and the ram lambs are kept on the most nutritious and invigorating food, in order to bring them to a great size, and make them excessively fat at two years old. They are then let to the breeders at very high prices. Whether this over-feeding is judicious or not is very doubtful; but it is natural to suppose that an animal which can be made so fat at an early age possesses a constitution well adapted to convert food into flesh and fat, rather than into bone and sinew, and, consequently, is more profitable to the grazier; and that this quality will be more or less imparted to his progeny. But the nature and quantity of the food required to fatten him should also be taken into consideration, for it is not always the fattest animal that gives the greatest profit, but the animal that gets to a certain degree of fatness on the smallest quantity or the cheapest kinds of food. Those extremely fat animals that are exhibited at shows are seldom very profitable on the whole when slaughtered; and a breed which fattens moderately, but quickly, may be much more profitable than one which will grow to a very great size, and become extremely fat, but slowly. This is one reason why the small highland cattle are in general so much more profitable to the grazier in moderate pastures, than the heavy Durham or Hereford breeds. Leicester sheep, which are very profitable on rich grass land, would scarcely live on the downs.

Pigs.—There was formerly a great prejudice in Scotland against the use of pork for food, and consequently that useful animal the pig was not much prized. The more frequent intercourse with England introduced the rearing and fatting of pigs as an article of commerce, and a great quantity of pickled pork and some bacon was exported from all the principal ports. The old prejudice is now almost entirely overcome, and pork adds much to the comforts of the farmer and the labourer. The breed of pigs has been much improved by careful selection and the importation of the best breeds. The Chinese pigs have contributed to this improvement by their great fruitfulness. No particular breed can be named as prevailing in Berwickshire, but some very good pigs are met with here and there; and, from their prolific nature, a very little attention will soon discover the most profitable kinds, and make the coarser be rejected. Bacon is not so generally used as in the south of England; pickled pork is preferred. The Scotch labourer does not waste the liquor in which the pork has been boiled, by throwing it into the hog-wash, but makes a mess with cabbages, peas, and oatmeal, in which the pig broth is an essential ingredient.

BOG. The name of bog has been given indiscriminately to very different kinds of substances. In all cases the expression signifies an earthy substance wanting in firmness or consistency, which state seems to arise generally (perhaps not always) from the presence of a superabundant supply of moisture having no natural outlet or drain.

In some cases, where springs of water, or the drainage from an extensive area, are pent up near the surface of the soil, they simply render it soft or boggy, and in this state the land is perhaps more properly called a quagmire. A second state of bog is where, in addition to the condition just described, a formation of vegetable matter is induced, which dying and being reproduced on the surface, assumes the state of a spongy mass of sufficient consistence to bear a considerable weight. Bogs of this description are numerous and extensive in Ireland, where they are valuable from the use made of the solid vegetable matter, both as fuel and as a principal ingredient in composts for manures. Where the turf has been cut away for these purposes, several bogs have been reclaimed by draining; and the subsoil is then readily brought into cultivation. Bogs also occur in all parts of Great Britain where the form of the surface and the nature of the earth favour the general condition under which bog is formed. Thus there are bogs on the high granitic plateau of Cornwall, on the road from Launceston to Bodmin; and in the large granitic mass, of which Brown Willy is the centre, the bottoms of the valleys are covered with bogs, the lower part of which is consolidated into peat. Although peat moss always springs from some moist spot, it will grow and spread over sound ground, and if not stopped by some natural or artificial impediment, such as a wall, would overrun whole districts. In this case it absorbs any moisture which reaches it, and retains it like a sponge.

The depth of a bog depends on the level of the surrounding grounds. It cannot rise much higher than the lowest outlet for the water. Where there is no immediate outlet the bog increases, until the evaporation is equal to the supply of the springs and rains, or till it rises to a level with its lowest boundary, where it becomes the source of a stream or river, and forms a lake. The mud being deposited at the bottom, gradually becomes a true peat, or is quite reduced to its elementary earths. In this case it may become a stratum of rich alluvial soil, which some convulsion of nature may lay dry, for the benefit of future ages. From this circumstance has arisen the great advantage of draining bogs, to which the attention of agriculturists and men of science has often been profitably directed. This subject is treated in the article on DRAINING.

The bogs of Ireland are estimated in the whole to exceed in extent two millions eight hundred thousand English acres. The greater part of these bogs may be considered as forming one connected mass. If a line were drawn from Wicklow head on the east coast to Galway, and another line from Howth head, also on the east coast, to Sligo, the space included between those lines, which would occupy about one-fourth part of the entire superficial extent of Ireland, would contain about six-sevenths of the bogs in the island, exclusive of mere mountain-bogs, and bogs of no greater extent than 800 English acres. This district resembles in form a broad belt drawn from east to west across the centre of Ireland, having its narrowest end nearest to Dublin, and gradually extending its breadth as it approaches the western ocean. This great division is traversed by the river Shannon from north to south, which thus divides the great system of bogs into two parts. Of these, the division to the west of the river contains more than double the extent of bogs in the eastern division, so that if we suppose the whole of the bogs of Ireland (exclusive of mere mountain-bogs, and of bogs of less extent than 800 acres) to be divided into twenty parts, twelve of these parts will be found in the western division, and five parts in the eastern division of the district already described, while of the remaining three parts, two are to the south and one to the north of that district.

The smaller bogs, excluded from the foregoing computation, are very numerous in some parts. In the single county of Cavan there are above ninety bogs, not one of which exceeds 800 English acres, but which collectively contain about 11,000 Irish, or 17,600 English, acres, without taking into the account many bogs, the extent of which is from five to twenty acres each.

Most of the bogs which lie to the eastward of the Shannon, and which occupy a considerable portion of the King's County and the county of Kildare, are generally known by the name of the Bog of Allen. It must not however be supposed that this name is applied to any one great morass; on the contrary, the bogs to which it is applied are perfectly distinct from each other, often separated by high ridges of dry country, and inclining towards different rivers as their natural directions for drainage.

The surface of the land rises very quickly from the Bog of Allen on all sides, particularly to the north-west, where it is composed, to a considerable depth, of limestone gravel, forming very abrupt hills. In places where the face of the hills has been opened the mass is found to be composed of rounded limestone, varying in size from two feet in diameter to less than one inch; the largest pieces are not so much rounded as the small, and frequently their sharp angles are merely rubbed off. They are usually penetrated by contemporaneous veins of Lydian stone, varying in colour from black to light grey. The colour of the limestone is usually light smoke grey, rarely bluish black: when it is bluish black, the fracture is large conchoidal; that of the grey is uneven, approaching to earthy. The Lydian stone, when unattached to the limestone, has usually a tendency to a rhomboidal form, sometimes cubical; the edges are more or less rounded; the longitudinal fracture is even, the cross fracture is conchoidal.

The Grand Canal from Dublin to Shannon Harbour passes through a considerable part of the great bog-district of Ireland. In forming this canal it was necessary to make considerable embankments, the surface-water of the canal being generally on a higher level than the surface of the immediately adjoining bogs. Where this was not the case advantage was taken of the circumstance to conduct the drainage of the bogs into trenches for the supply of the canal.

The bogs situated to the south of the great belt in the centre of Ireland occur in Tipperary, Kilkenny, Clare, and Queen's County; those to the north of that belt occur in Antrim, Down, Armagh, Tyrone, and Londonderry.

It appeared from the examination of the surveyors appointed by parliament in 1810 to investigate the nature and extent of the bogs in Ireland, that they consist of 'a mass of the peculiar substance called peat, of the average thickness of twenty-five feet, no where less than twelve, nor found to exceed forty-two—this substance varying materially in its appearances and properties in proportion to the depth at which it lies: the upper surface is covered with moss of various species, and to the depth of about ten feet is composed of a mass of the fibres of similar vegetables in different stages of decomposition, proportioned to their depth from the surface, generally however too open in their texture to be applied to the purposes of fuel; below this generally lies a light blackish-brown turf, containing the fibres of moss, still visible though not perfect, and extending to a further depth of perhaps ten feet under this. At a greater depth the fibres of vegetable matter cease to be visible, the colour of the turf becomes blacker, and the substance much more compact, its properties as fuel more valuable, and gradually increasing in the degree of blackness and compactness proportionate to its depth; near the bottom of the bog it forms a black mass, which when dry has a strong resemblance to pitch or bituminous coal, having a conchoidal fracture in every direction, with a black shining lustre, and susceptible of receiving a considerable polish.'

The surface of Irish bogs is not in general level; indeed it is most commonly uneven, sometimes swelling into hills and divided by valleys, thus affording great facilities for drainage. None of the bogs of Ireland which have been described occur on low ground, a fact which seemed to strengthen the opinion of their having always originated from the decay of forests. This theory of the original formation of bogs was at one time very generally adopted, but the result of more recent investigations shows that it cannot be supported. That some bogs may have been formed in this manner is not denied. It is stated in the *Philosophical Transactions*, No. 275, that—'The Romans under Ostorius, having slain many Britons, drove the rest into the forest of Hatfield (in Yorkshire), which at that time overspread all the low country; and the conqueror, taking advantage of a strong south-west wind, set fire to the pitch trees of which the forest was chiefly composed, and when the greater part of the trees were thus destroyed, the Roman soldiers and captive Britons cut down the remainder, except a few large ones, which were left growing as remembrancers of the destruction of the rest. These single trees did not long withstand the action of the winds, but falling into the rivers intercepted their currents, and caused the waters to rise and flood the whole flat country; hence the origin of the mosses and moory bogs which were afterwards formed there.' This moorland near Hatfield, seven miles north-east of Doncaster.

and about Thorne, is now a boggy peat covered with heath, several feet higher than the adjoining land, and very wet; whence it has been aptly compared to a sponge full of water. The Thorne waste with some adjacent tracts, and the Hatfield moor, contain about 12,000 acres.

In the *Ordnance Survey of the County of Londonderry*, presented by Lord Mulgrave to the British Association during its recent meeting (Aug. 1835) in Dublin, are some remarks on the subject which are deserving of attention ;—

'In the production of bog, *sphagnum*[*] is allowed on all hands to have been a principal agent, and superabundant moisture the inducing cause. To account for such moisture various opinions have been advanced, more especially that of the destruction of large forests, which, by obstructing in their fall the usual channels of drainage, were supposed to have caused an accumulation of water. That opinion however cannot be supported; for, as Mr. Aher remarks in the *Bog Reports*, such trees as are found have generally six or seven feet of compact peat under their roots, which are found standing as they grew, evidently proving the formation of peat to have been previous to the growth of the trees, a fact which, in relation to firs, may be verified in probably every bog in this parish, turf from three to five feet thick underlying the lowest layer of such trees. This fact is indeed so strongly marked in the bog which on the Donegal side bounds the road to Muff, that the turf-cutters, having arrived at the last depth of turf, find timber no longer, though formerly it was abundant, as is proved by their own testimony from experience, and by the few scattered stumps which still remain resting on the present surface. Not so however with oaks, as their stumps are commonly found resting on the gravel at the base, or on the sides of the small hillocks of gravel and sand which so often stud the surfaces of bogs, and have by Mr. Aher been aptly called islands. He further adds that in the counties of Tipperary, Kilkenny, &c., they are popularly called *derries* (signifying *a place of oaks*), a name deserving attention, whether viewed as expressive of the existing fact, or as resulting from a lingering traditionary remembrance of their former condition, when, crowned with oaks, they were distinguishable from the dense forest of firs skirting the marshy plains around them. The strong resemblance to antient water-courses of the valleys and basins which now contain bogs, and the occurrence of marl and shells at the bottoms of many, naturally suggest the idea of shallow lakes, a view of the subject adopted in the *Bog Reports* by Messrs. Nimmo and Griffiths. Such lakes may have originated in the natural inequalities of the ground, or been formed by the choking up of channels of drainage by heaps of clay and gravel, or they may have been reduced to the necessary state of shallowness by the gradual wearing away of obstacles which had dammed up and retained their waters at a higher level.'

The probable process of the formation of bog in such cases is thus explained in the *Ordnance Survey*:—'A shallow pool induced and favoured the vegetation of aquatic plants, which gradually crept in from the borders towards the deeper centre. Mud accumulated round their root and stalks, and a spongy semi-fluid mass was thus formed, well fitted for the growth of moss, which now, especially *sphagnum*, began to luxuriate. This, absorbing a large quantity of water, and continuing to shoot out new plants above, while the old were decaying, rotting, and compressing into a solid substance below, gradually replaced the water by a mass of vegetable matter. In this manner the marsh might be filled up, while, the central or moister portion continuing to excite a more rapid growth of the moss, it would be gradually raised above the edges, until the whole surface had attained an elevation sufficient to discharge the surface-water by existing channels of drainage, and calculated by its slope to facilitate their passage, when a limit would be in some degree set to its further increase.'

According to the personal observations of Mr. Griffiths, made during many years, the growth of turf in these bogs is very rapid, amounting sometimes to two inches in depth in one year: this however is stated to be an excessive growth under peculiarly favourable circumstances.

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[*] Sphagnum palustre.

The roots which were attached to the ground decay, and the whole of the surface becomes a floating mass of long interlaced fibres, which when taken out has been significantly called in Ireland *old wives' tow*. The black mass of the bog is a mud almost entirely formed of decomposed vegetable fibres, but not of sufficient specific gravity to sink to the bottom; thus producing that semi-liquid state which distinguishes a quaking bog from a peat-moss. The vegetation which continues on the surface and at some depth below, has the appearance of a fine green turf. In many cases the roots are so matted together, and so strong, as to form a web capable of bearing the gentle and light tread of a man accustomed to walk over bogs, bending and waving under him without breaking; and, while a person unskilfully attempting to walk upon it would infallibly break through and be plunged in the bog, like a venturous skater on unsound ice, the practised *bog-trotter*, with proper precautions, passes over them in safety. This has often been of considerable advantage in war, or in the pursuit of illegal employments. The fugitive escapes over his native bogs, where the pursuer cannot venture to follow, or if he does, he generally pays the penalty of his ignorance or rashness, by sinking in them. Many examples of this were witnessed in Ireland during the last rebellion, and many bodies have been found in bogs years after, preserved from decay, and tanned in a manner by the astringent principle, which is always found where vegetable fibre has been decomposed under water.

When bogs become consolidated or compressed, they are called peat-mosses. The consolidation here mentioned must be carried to a considerable extent before the soil is capable of sustaining such a growth of timber as it is seen to have frequently borne.

'Successive layers of trees (or stumps) in the erect position, and furnished with all their roots, are,' as stated in the *Ordnance Survey*, 'found at distinctly different levels, and at a small vertical distance from each other. It appears that the consolidation of the lower portion of the turf was a necessary preparation for the first growth of timber, and considering the huge size of the roots thrown out by these trees, and the extent of space over which they spread, the mode is readily perceived by which they obtain a basis of support sufficiently firm and extensive to uphold their rising and increasing stems. The first layer of turf was now matted by the roots, and covered by the trunks of the first growth of timber, but as the bog still continued to vegetate, and to accumulate round the growing stem, a new layer of turf was created to support a second growth of timber, the roots of which passed over those of the preceding, and so on with a third or more, until at length the singular spectacle was exhibited of several stages of trees growing at the same time. Such seems a natural way of viewing the subject, but it is often stated that one stump is found actually on the top of another, which would imply that the lower tree had been destroyed before the turf had ascended to the level of the broken stump. In such an instance, using Mr. Griffiths's example of the rate of increase of recent bog, and supposing it compressed by growth into one-fifth of its original bulk, little more than one hundred years would have elapsed between the two periods.'

An extensive tract of peat-moss (Chat-moss) in the county of Lancaster has lately attracted public attention from the circumstance of the Liverpool and Manchester Railway having been carried through it. The length of Chatmoss is about six miles, its greatest breadth about three miles, and its depth varies from ten to upwards of thirty feet, the whole of which is pure vegetable matter throughout, without the slightest mixture of sand, gravel, or other material. On the surface it is light and fibrous, but it becomes more dense below. At a considerable depth it is found to be black, compact, and heavy, and in some respects resembles coal: it is in fact exactly similar to the composition of the bogs of Ireland, as already described.

The moss is bounded on all sides by ridges of rolled stones mixed with clay, which prevent the immediate discharge of its waters. It is probable that this bar, by interrupting the course of the waters, originally caused the growth of Chatmoss. This moss presents at its edges nearly an upright face; the spongy surface of the moss being elevated at a very short distance from the edge from ten to twenty feet above the level of the immediately adjoining land. The immediate substratum to the bog is a bed of siliceous sand, which varies from one to five feet in thickness, below which is a bed of bluish and sometimes reddish clay marl of excellent quality. This marl varies in thickness very considerably; in some parts it is not more than three feet, in others its depth has not been ascertained; below the marl is a bed of sandstone gravel of unknown thickness. It is this bed of gravel which extends beyond the edge of the bog, and prevents the direct discharge of the waters from the flat country to the north into the river Irwell. The depth of Chatmoss varies from fifteen to thirty feet. (See also Camden's remarks on this moss, vol. ii., p. 966, Gibson's edition.)

About 1797 the late Mr. Roscoe of Liverpool began to improve Trafford-moss, a tract of 300 acres, lying two miles east of Chatmoss, which operation was so successful as to encourage him to proceed with the improvement of Chatmoss, the most extensive lowland bog in England, including 7000 acres. After first constructing sufficient drains, the heath and herbage on the moss were burnt down as far as practicable; a thin sod was then ploughed with a very sharp horse-plough, burned in small heaps, and the ashes spread around. Being then tolerably dry, and the surface level, the moss was ploughed six inches deep, and the necessary quantity of marl, generally not less than 200 cubic yards to the acre, was set upon it. When this began to crumble and fall by the action of the sun or frost, it was spread over the land with great exactness, and the first crop was put in as speedily as possible, with the addition of about twenty tons of manure to the acre. The first crop, which must be put in with the plough, or with the horse-scuffle or scarifier, may be either a green crop, as potatoes, turnips, &c., or any kind of grain. After making a great variety of experiments, Mr. Roscoe gave it as his decided opinion, 'that the best method of improving moss-land is that just stated, of the application of a calcareous substance, in sufficient quantity to convert the moss into a soil, and by the occasional use of animal or other extraneous manures, such as the course of cultivation and the nature of the crops may be found to require.' The cost of marling was stated by Mr. Roscoe at 10*l.* per acre, at which cheap rate it would not have been possible to have performed the work but for the assistance of an iron railway, laid upon boards or sleepers, and moveable at pleasure. Along such a road the marl was conveyed in waggons with small iron wheels; each waggon, carrying about 15 cwt., was drawn by a man, and this quantity was as much as, without the employment of the railway, could have been conveyed over the moss by a cart with a driver and two horses.

In June, 1833, an ancient wooden house was discovered in Drumkelin Bog, in the parish of Invernon, near the north coast of the county of Donegal in Ireland, by James Kilpatrick, while he was searching for bog timber. The description of the house and the other circumstances connected with it were given by Captain Mudge, who was then engaged in surveying the coast, to the Hydrographer of the Admiralty, and by him communicated to the Society of Antiquaries in the November following. The roof of the house was four feet below the present surface of the bog; but it is estimated, by comparing the present surface with that of adjacent parts from which no peat has been taken, that the top of the roof must have been about sixteen feet below the surface before any peat was removed. The framework of the house was very firmly put together, without any iron; the roof was flat and made of thick oak planks. The house was twelve feet square and nine high: it consisted of two floors one above the other, each about four feet high; one side of the house was entirely open. The whole stood on a thick layer of sand spread on the bog, which continues to the depth of fifteen feet below the foundation of the house. Captain Mudge supposes that a stone chisel, which was found on the floor of the house, had been used in making the grooves and holes in the timbers, as the chisel corresponded exactly to the cuts and holes. When the house was removed from the bog, and a drain had been opened to carry off the water which flowed into the hollow, a paved pathway was traced for several yards, at the end of which was discovered a hearthstone made of flat freestone slabs. The hearthstone was covered with ashes, and near it were several bushels of half-burnt charcoal, with nutshells, some broken and others charred, besides some blocks of wood partly burned. On the same level as the foundation of the house stumps of oak trees were found standing, just such as had supplied the timber of the house; and beneath all this, as already observed, there are still fifteen feet of peat. It is the opinion of Captain Mudge that this house must have been suddenly overwhelmed by boggy matter, a conclusion which appears necessary to explain all the circumstances.

Bogs not unfrequently burst out and suddenly cover large tracts. This phenomenon happened in the year 1835, in Ireland, on a part of Lord O'Neill's estate, on the Ballymena road, in the neighbourhood of Randalstown. On the 19th September an individual near the ground was surprised by hearing a rumbling noise as if under the earth, and immediately after a portion of the bog moved forward a few perches, when it exhibited a broken rugged appearance, with a soft peaty substance boiling up through the chinks. It remained in this state until the 22nd, when it again moved suddenly forward, covering corn-fields, potato-fields, turf-stacks, hay-ricks, &c. The noise made by its burst was so loud as to alarm the inhabitants adjoining, who, on perceiving the flow of the bog, immediately fled. It directed its course towards the river Maine which lay below it; and so great was its force, that the moving mass was carried a considerable way across the river. Owing to the heavy rain which had fallen for some time previously, the river forced its channel through the matter deposited in its bed, and considerable damage was thus obviated, which would otherwise have occurred from the forcing back of the waters. It is stated that upwards of 150 acres of arable land have been covered by this outbreaking of the bog.

BOG-EARTH is an earth or soil composed of light siliceous sand and a considerable portion of vegetable fibre in a half decomposed state, such as is often found accumulated over an impervious substratum, where the waters have deposited the mud carried off from boggy places. It is in high repute with gardeners, being excellent for flowers, especially for some American plants, which thrive best in such a soil. The most fertile kind consists of nearly 25 per cent. of vegetable matter, and when mixed up with good mould, and if necessary with some quick-lime, to promote the further decomposition of the fibres, it is far superior to any artificial manure. Where it is not to be obtained in a natural state, it is easily imitated artificially, by mixing the mud of ponds or ditches, where the soil is light, in pits, with leaves, weeds, and grass, keeping the mixture well watered and frequently turned. It must then be exposed to the air for a considerable time in heaps, until the requisite texture is produced. Some sharp sand is an essential ingredient, and must be added if there is none in the soil.

BONES have been of late years very extensively used as manure, especially on poor and dry sands and gravels. Many cargoes from abroad have been imported for this purpose into the eastern ports of Britain. Bones have thus become a considerable article of commerce with Germany, Belgium, and Holland: so much so that the governments of some of these countries have had it in contemplation to subject them to an export duty.

Experiments on bones as a manure were made long before their use was extensively adopted, and these, in general, were not attended with a very favourable result, in consequence of the bones not being broken into sufficiently small pieces, or being put upon the land in too fresh a state. But since mills have been erected to crush them to a small size, and the proper use of them has been ascertained, the advantage of this manure, in distant and uncultivated spots, where the carriage of common stable or yard manure would have been too expensive, and where it could not be made for want of food for cattle, is incalculable. By means of bones large tracts of barren sands and heaths have been converted into fertile fields.

The bruising or grinding of bones has become a distinct business, and they may be bought in London and at the principal ports ready to put upon the land. They are broken into different sizes, and are accordingly called *inch bones*, *half-inch bones*, and *dust*. Most of the bones procured from London and the manufacturing towns have undergone the process of boiling, by which the oil and a great part of the gelatine which they contain have been extracted.

At first sight we should be led to imagine, that having lost much of the rich animal matter which they contained, they would be proportionably less effective in the soil. This, however, does not seem to be the case from the comparative experiments made with bones which had been subjected to boiling, and those which were quite fresh. All those who have used bones extensively report that little difference can be observed between them: some even give the preference to those from which the oil and glue have been extracted. But oil and glue form excellent manures. How is this to be explained? It appears, from the result of many experiments, that bones do not furnish much nourishment to the roots of plants until they have undergone a certain degree of decomposition. The fat and the gelatine, being intimately blended with the bony matter, and contained in cavities or cells, may remain a long time in the earth without decomposition. As a proof of this, it has been found that bones which had lain in the earth for many centuries, on spots where ancient battles were fought, afforded, on analysis, nearly as much gelatinous matter, by the abstraction of the earthy parts, as fresh bones would have done. Bones analysed by Fourcroy and Vauquelin were found to consist of

	Parts.
Solid cartilage, gelatine and oil . . .	51
Phosphate of lime .	37·7
Carbonate of lime .	10
Phosphate of magnesia	1·3
	100

It would seem, then, that the great effect of bones, as a manure, must depend on the phosphate of lime; and the effect of bone-ashes seems to strengthen this opinion. But a close examination of the fields manured with bones has led us to surmise that much of their importance depends on the mechanical texture of the bone, and on its power of absorbing and retaining moisture; for if a plant which vegetates with peculiar vigour in a field manured with bones be pulled up, it will be almost invariably found that small pieces of bone are attached to the roots; and when these are minutely examined, the smaller fibres of the roots will be found to have grasped them, and to pervade their cavities, which will always be found more or less moist. The moisture, then, and a small portion of the remaining gelatine dissolved in it, forms the food on which the plant has thriven. The more the bones have undergone fermentation, the more soluble the gelatine will be. In its fresh state, it is only soluble in very warm water, and the oil repels moisture. This accounts for the seeming anomaly of the superiority of boiled bones. They have undergone a fermentation. The residue, although not deprived of all its animal matter, is much more porous, and will imbibe and retain moisture in its pores. The food of the plants is here ready prepared and dissolved, and kept in store without being in danger of being washed through a porous soil or evaporated by the heat. The solid substance, which is chiefly phosphate of lime, has a stimulating effect, and assists that of the more soluble parts. But phosphate of lime is not soluble in water, and does not decompose readily in the earth; its effect therefore is not so great as to account for the general result. The universal experience of all those who have used bones as a manure proves that they are of little or no use in very stiff or wet soils. In stiff clays the pieces of bone are bedded in a tough substance, which prevents their decomposition; and in very wet soils the advantage of these small but numerous reservoirs of moisture is lost. Hence it is easily seen why bones are of less use in such soils.

But it is ascertained that the effect of bones on the crop is much increased when they have been previously mixed in heaps with ashes, burnt clay, or light loam, or made into a compost with the dung of animals, and with vegetable substances. In this case, the fresh bones will evidently be much more advantageous than those which have been boiled; for the fermentation will extract and decompose the oil and a great part of the gelatine, which, mixed with the other ingredients of the compost, will much enrich them; while the bony residue will be in the same state as it would have been if the bones had come from the boiling-house. By comparing all the facts, we naturally come to the conclusion, that the most economical use of bones is to extract from them the oil and gelatine, which, if not of sufficient value for the manufacture of glue or of ammonia, may be used as a supplementary food for pigs, in the form of a broth or pot liquor, which, mixed with meal, will greatly accelerate their growth or increase their fat. For this purpose the bones should be broken in the mill to a moderate size, like those called *inch* bones; they should then be boiled or steamed for several hours, and the liquor strained; this, on cooling, will be found to form an animal jelly of more or less strength, which may be thickened by boiling, and finally dried into a glue or portable soup, which will keep for a considerable time.

The price of fuel and attendance being calculated, it will be seen whether this operation is a real economy or not; if not, the bones may be allowed to ferment in a heap, mixed with sand or coal-ashes. In this case, they may be ground at once to the size called half-inch; in the other, they may be passed again through the mill after having been boiled.

The mode of applying bones as manure to the land is either by sowing from twenty to forty bushels of them per acre by the hand broadcast, as is done with corn, and harrowing them in with the seed; or by putting them into the drills by a machine made for the purpose, which is an addition to the common drilling machine. This is the most approved method, and the crop for which they are best adapted is turnips, after the land has been well cleaned and tilled. About twenty-five bushels per acre is sufficient to produce a good crop on poor light sands, and it does not appear that beyond this quantity they have a proportional effect. It is better therefore to repeat the dressing than to put on much at once. When used as a top-dressing for grass-land, they have, in some instances, produced a great and very durable improvement, when the quantity was large; but in most other cases it has been found much more advantageous to reserve them for turnips or corn. Bones have been drilled with wheat, at the rate of thirty bushels of bones and two and a half of wheat per acre, and a good crop (twenty-four bushels per acre) has been obtained on very poor soil: while portions of the same field sown without any bones, in order to ascertain the effect, did not produce sufficient plants to cover the ground or return the seed.

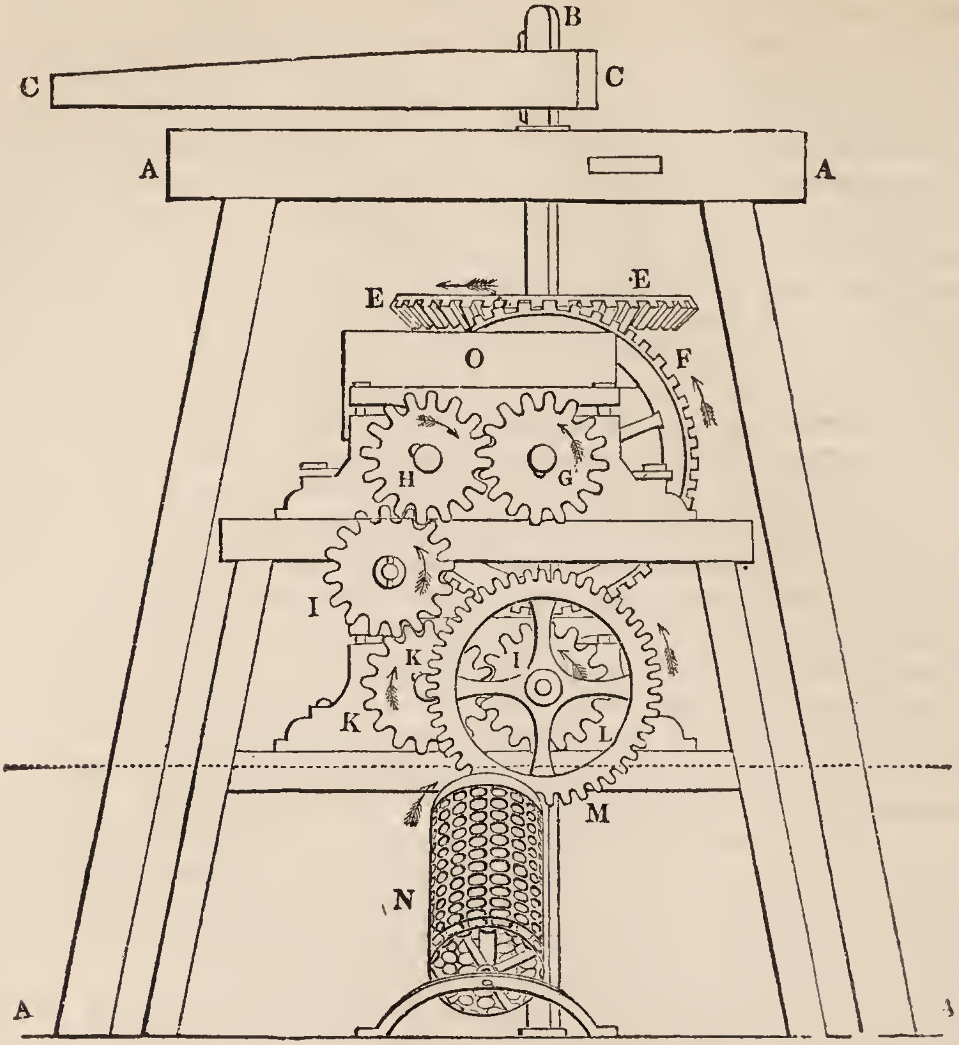
When bones are compared with farm-yard dung the result has been various, and chiefly owing to the seasons and the nature of the land. In strong loams or in very moist seasons the farm-yard dung, put on at the rate of from ten to fifteen tons per acre, has decidedly the advantage, not only for the turnips but for the subsequent crops. On very dry gravelly soils and in dry summers the bones produced the best turnips; and when the comparative cost is taken into consideration, and the saving of time in the light carriage of the bones, it will be seen that the bones are much more economical. Besides this, farm-yard or stable dung cannot always be procured in any considerable quantity, while bones may be had almost to any amount, if bespoken in proper time. Many large tracts of waste land have been brought into cultivation by means of bones, as the only manure which could be procured, and without which they must have remained in a barren state. Bones have also been compared with rape-cake and malt-dust, but there has not been a sufficient number of experiments, made carefully, to give an accurate comparison. It is highly probable that these last, when they can be procured sufficiently cheap, would greatly assist the effect of bones if mixed with them, and would render the success of a crop of turnips more certain under all circumstances of soil or season. Every practical farmer knows that a good crop of turnips is the foundation of all the subsequent crops in the course. A great advantage of manuring land with bones is that they introduce no weeds, which farm-yard dung inevitably does. This is probably the reason why they have been chiefly used on land which has been fallowed; and turnips being the usual crop first sown on such light lands as are most benefited by bone-manure, the greatest number of experiments have been made with this crop. That they are an excellent addition to the list of artificial manures previously used is very clearly shown by the answers to queries made by the Doncaster Agricultural Association, of which an interesting report has been published. Whatever difference there may be in the opinion of some of the numerous agriculturists who have sent answers on this subject, as to the effect of bones on different soils, all who have tried them to any extent have continued the use of them. This simple circumstance says more in favour of bones than the most elaborate argument, and the only question will be, at what expense they may be procured, and on what lands they have the best effect. When the immense quantity of bones from the cattle daily slaughtered is considered, and the readiness with which any commodity for which there is a demand is procured in commerce, there can be no great fear of a deficient supply. But it is probable that the price may be so increased by a great demand as to make it a matter of nice calculation, whether their use may be attended with profit or not. If once they are very generally used, their price will arrive at a maximum, and find its natural level. At present they may be obtained in London and at the principal ports for about 2*s.* per bushel coarsely ground, and 2*s.* 6*d.* to 3*s.* when in a finer state; and at that price, with a small addition for carriage, they will be found the cheapest manure that can be purchased for dry, gravelly, and sandy soils.

The mill which is used to break and grind bones consists of two iron or steel cylinders, with grooves running round their circumference, the projections being cut so as to form strong teeth. These turn upon one another by means of machinery, so that the teeth of one run in the groove between the teeth of the other, as may be seen in the annexed cut.

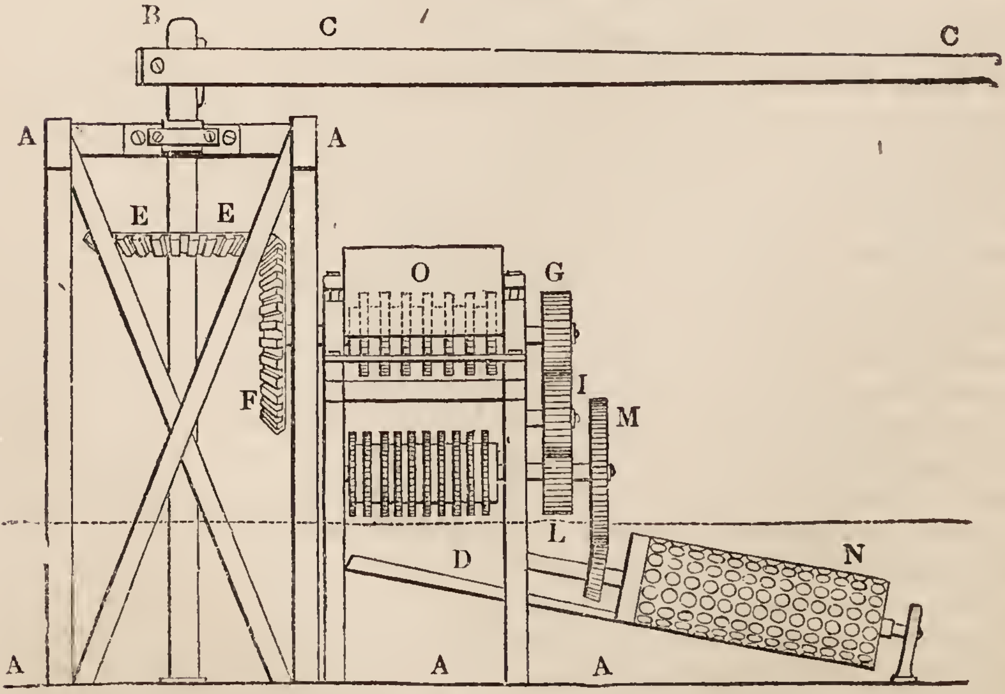
An instrument has also been invented for distributing bones, ashes, rape-dust, and similar dry manures in the drills at the same time with the seed. It consists of a very simple addition to the common drilling machine, and is described under the word Drill.

The bones put in the hopper O are seized by the teeth of the two upper cylinders and broken in pieces, which fall in between the lower pair, where they are reduced to a smaller size. From these they fall on a slanting board D and slide into the wire cylinder. All the smaller pieces pass through the interstices of the wire: those which have not been sufficiently broken come out at the end and are returned into the upper hopper. Where a machine of this description can be attached to a water or windmill, or to a steam-engine, the bones are broken at a small expense; when horses are used, the expense is greater; and a hand-mill can only be of use where there is a great superabundance of manual labour, and only a small quantity of bones are required.

A, A, is the frame of a bone-mill strongly fixed to the floor; B, the axis of the machinery, which is turned by the lever C, C, to which the power is applied; E, E, is a horizontal wheel with bevelled teeth moving a vertical wheel F, on the axis of which one of the cylinders with grooves and teeth is fixed. At the other end of the axis is a smaller wheel G, turning a similar one, H, on the axis of the other cylinder, making the toothed surfaces turn towards each other, and thus crushing between them the bones which the hopper O supplies. Another pair of cylinders similar to the first, but with smaller teeth, are turned by means of the intermediate wheel I working in the wheel L fixed



[End elevation of Bone-grinding Machine.]



[Side Plan of the Bone-grinding Machine.]

to the axis on which is a larger wheel M, working in a pinion which turns the cylindrical sieve N. The arrows indicate the direction of the motion.

BRABANT, AGRICULTURE OF.—Dutch or North Brabant is naturally a poor barren country, part of which consists of sandy heaths, part of low marshes, neither of which are well adapted to cultivation. Industry has, in some measure, overcome these natural disadvantages; and the traveller will often admire fine crops of corn and flax, and neat plantations of tobacco on spots which, a short time ago, were arid sands and barren heaths. Specimens of the natural soil often appear immediately adjoining the cultivated spots, and show the industry and perseverance of the inhabitants. The sands of Dutch Brabant and of the north part of the province of Antwerp are much less susceptible of cultivation than those of East Flanders. They are higher above the natural waters, and are more impregnated with carbonates and oxides of iron; hence they are more apt to burn, and require much lime, which is not found in the neighbourhood, to correct the natural qualities. In many places the soil resembles the most barren spots of Bagshot-heath in England. Where the rivers have deposited a rich alluvial loam the land is very fertile, but it is generally situated so low, and is so subject to be flooded, that it requires a great expense to protect it by dykes, and it is mostly left in the state of meadows.

The north part of Austrian Brabant, now called the Province of Antwerp, especially that part which lies north of that city, is almost entirely of the same barren nature. It is only in the neighbourhood of Antwerp that there is any appearance of fertility, and this is to be ascribed solely to the abundance of manure which the town affords, and the demand for all kinds of vegetables for its market.

The south part of this province, towards Malines, improves as you advance, and gradually loses that very flat appearance which distinguishes the Netherlands. The surface is more undulating, and there are some rich loamy fields in the valleys, and woods on the eminences.

South Brabant, which begins a little to the south of Malines, presents a much more varied aspect, and possesses a much greater extent of good soil. A line may be drawn from west to east through Aerschot and Diest, along which there are some very fertile loams producing fine crops without much labour; as also towards Louvain and Tirlemont. These loamy soils, which are neither very light nor very stiff, predominate in all the valleys throughout the province, varying in quality and depth, and covering many rising grounds which barely deserve the name of hills. The higher grounds are covered with a poorer and more sandy stratum of no great depth, as is evident from the fine trees which grow upon them, and show plainly that there is a good soil below the surface. A range of these hills runs at a little distance to the south of Brussels, and along their brow are the well-known woods, which cover 20,000 acres, and skirt the field of Waterloo, forming a kind of barrier or part of a belt to the south of the capital.

The best soils in South Brabant are towards Flanders and Hainault, which last may be considered as possessing the most fertile soils in the kingdom of Belgium. Judging from the rich appearance of the crops in the neighbourhood of Tournay and along part of the road from thence to Brussels, travellers have been led to overrate the natural fertility of Brabant, and to attribute to the goodness of the soil what is more properly due to industry and good husbandry. From attentive personal inspection we are inclined to believe, that the general fertility of the whole district between Malines and Tournay in one direction, and Louvain and Namur in another, which includes the richest part of Belgium, does not, on the whole, exceed the average fertility of the inland counties of England, and is decidedly inferior to the rich alluvial soils called the *carses* in Scotland. The dryness of the summer prevents so extensive a cultivation of turnips as in England; but this is counterbalanced by the advantage of distilleries, which are attached to most of the principal farms, and by means of which a great part of the produce is consumed on the spot by stalled cattle, who are fatted on the refuse wash, and make an abundance of manure. The liquid part of the manure is collected in large tanks or reservoirs, and used either immediately on the land, or to accelerate the fermentation of the drier portions, by pouring it over the dung-heaps and composts.

The general system of husbandry in Brabant is very different from that in Flanders, and approaches much nearer to the most improved systems in England and Scotland. In some respects it is superior, in others not so; and both countries might improve in practical agriculture by mutually adopting practices, as far as is consistent with the difference of situation and climate, in which one country is more advanced than the other. The climate of Brabant is less variable and drier than that in the same parallel in Great Britain. The winters are colder, the frost more intense, and the snow lies longer on the ground. They are not so subject to late frosts in spring. In consequence of this their harvest is earlier. They have in general fine dry weather after harvest, in which the land may be cleared of root-weeds; and in this they spare no pains.

The crops in Brabant are not so varied as in Flanders. The larger extent of the farms does not allow so minute cultivation, nor so frequent a use of the spade; but from the moment the crop is severed from the ground, before it is out of the field, ploughs, rollers, and harrows are at work, and the hard ground is moved to the depth of only two or three inches by means of light sharp ploughs; it is repeatedly harrowed to encourage the germination of the seeds of annual weeds, and destroy those that have come up; the root-weeds are carefully pulled up and burnt, and thus the land is cleaned, and all the advantages of a summer fallow are obtained. In autumn, after some showers have softened the earth to a moderate depth, the land is ploughed again to a greater depth, and either prepared and manured for immediate sowing, or laid up in ridges to receive the beneficial influence of the winter's frost, and be ready for spring sowing. In case it should not be sufficiently clean, according to the notions of the farmer, a crop of potatoes on light soils, or of beans and vetches mixed, to be cut green, on the stiffer, afford the means of destroying weeds. Barley is mostly sown in autumn, and of the winter sort; but spring barley begins to be extensively cultivated, especially since the *chevalier* barley has been introduced from England, which is as heavy and better for malting than the winter barley in common use before. Rye, both for bread and for distilling, is always a principal crop, and bears a higher price, in proportion to wheat, than it does in England. Clover is seldom sown with a spring crop, because they think, and perhaps not without reason, that a genial spring brings the clover-plant so fast forward as to injure the crop sown with it. They prefer sowing clover amongst rye or wheat, which being arrived to a certain strength, is not so likely to be injured by the young clover; whilst it gives sufficient shelter and protection. Wheat is often sown after winter barley, especially if they can get some turnips on the barley stubble, between the reaping of the one and the sowing of the other. Turnips seem to sweeten the ground, and with moderate manuring the wheat is generally good. The cultivation of beans all over Belgium is the most imperfect: they are usually sown broadcast, mixed with tares or peas. The land is certainly kept clean by so close a crop, but, except it be cut up green for fodder, the produce is not very great; neither beans nor peas have room and air to perfect their pods, and only a few on the surface come to perfection. One of the greatest improvements in Belgian agriculture would be the drilling or dibbling of beans, and hoeing them by horse or hand hoes to prepare the land for wheat; at present they scarcely seem to know the value of this crop when well managed.

There is no particular rotation generally adhered to. The fields are cropped according to the wants of the farmer and the state of the land. An abundance of manure allows of rapid returns of white straw crops. All the clover, with little exception, is used green in the stables as food for horses and cattle. Potatoes, if not used to distil a spirit from them, are also chiefly consumed on the farm by cattle and pigs. Little hay is made in comparison with the quantity of the stock kept in winter. The chief reliance is on roots when green food fails. As a consequence of a scarcity of dry fodder, the young and store cattle have little else but straw in winter, and sometimes get so low in condition as to suffer greatly in cold seasons, and be a long time in recovering flesh. This is a defect which the best agriculturists in Belgium acknowledge, and endeavour to correct by their example, but prejudice and custom are every where opposed to, and retard, rational improvement.

In rich deep soils hemp and flax are cultivated to a great extent, and also rape and cole for seed. These are always highly manured, and usually succeeded by wheat, which thrives well after them. Tobacco has been tried in a few places, and seems to flourish. Maize or Indian corn may be seen growing here and there, but not to any extent. In dry warm summers, like those of 1834 and 1835, this grain ripens well and is very productive, but in most years the spring is too late and cold for this plant, which cannot bear frost in its tender state. The variety which succeeds best is that called the *quarantain*. It is supposed in a warm climate to ripen in forty days. This dwarf variety was warmly recommended by the late William Cobbett, who gave it the name of Cobbett's corn. An attempt has been made under the auspices of the government to introduce the rearing of silk-worms into Belgium, and a considerable establishment has been formed near Ath in Hainault, which appears to succeed. It is probable, however, that the occasional failure of the white mulberry leaf will cause occasional losses, and that as long as silk can be obtained from Italy, the south of France, and India or China, the northern countries will never be able to rear silk-worms with any advantage.

The peasantry of South Brabant and Hainault, which is called the Walloon country, have a dialect of their own, and are a very different race from the Flemish or the Dutch. The men are tall and muscular; and many may be met with who recall to mind those bold mercenaries who formerly served in war any one who would pay them, and were known by the name of Brabançons or Walloons. The women of the country are large and inclined to corpulency as they advance in years, owing probably to an abundant use of beer. They are not remarkable for elegance of figure, and the total absence of stays, or any support to the body, makes an abundance of flesh more conspicuous. The female figures in the pictures of Rubens are a very accurate representation of the country women in Flanders and Brabant. This feature, however, diminishes as you travel southward, and towards Hainault and Liege some very neat figures of women may be seen.

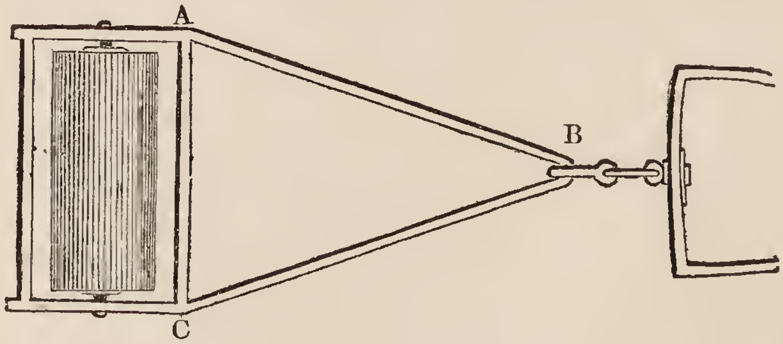
The cattle in Brabant are of a large and coarse kind, more calculated for strength of draught than for activity. The Belgians have not yet discovered that a moderately sized animal may be more profitable than a larger; or that a small cow with slight bones, like the Alderney cow, the Suffolk or the Ayrshire, may give as much and richer milk, on less food, than one of their heavy and coarse animals. The government has taken pains to introduce improved breeds, and money has been expended for that purpose, but the prejudices of the peasants are not easily overcome; and they seem not yet inclined to take advantage of the good intentions of their rulers. A few individuals have availed themselves of the opportunity to purchase cows and bulls of a finer breed imported from England, and will probably be the means of opening the eyes of others, when it is observed that the finer breed is more profitable than the old.

The horses are large and strong, and on the whole fully equal to the general run of farm horses in England. They might be much improved by a cross with the more active Yorkshire or Lanarkshire horses. Most of the Belgian horses have a great defect in the form of their hips and in the croup, which falls suddenly towards the tail, which is called in England being *goose-rumped*.

The sheep are of a very inferior kind, long in the leg, with coarse wool and hanging ears. A few good Leicesters and improved Cotswold sheep have been introduced, and will probably improve the native breed. The fleece of a very fine ram imported from England being sorted and combed was exhibited in 1835 at Brussels at the annual exhibition of the industrious products of the country, and excited universal admiration for the length and fineness of the staple, and especially for the quantity of the wool. The whole fleece when shorn weighed twenty pounds, and of this nine pounds of fine long dressed wool was obtained.

The Belgian pigs are similar to the French, and nearer to the shape of greyhounds than of pigs, with long sharp snouts, and very long legs, the whole body being in the form of an arc of a circle, and very thin. A better breed has, however, been introduced, and, from the naturally prolific nature of the animal, will soon spread and supersede the old breed. There is a general spirit of agricultural improvement amongst landed proprietors in the country, which the government is anxious to encourage.

The implements of husbandry used in Brabant are few and of the simplest kind. They use the excellent Flemish swing plough, which they call a foot-plough, as it is also called in some parts of England, in contradistinction to a wheel-plough. At the same time they also retain the old and heavy turn-wrest plough, with a shifting coulter and mould-board, as may be still seen in Kent and Sussex; yet they allow that the light Flemish plough does the work as well in the stiffest soils, and requires less force. It is surprising that two instruments so very opposed to each other in principle should be used on the same farm and in the same kind of soil, but the turn-wrest plough is the indigenous instrument, and requires less skill in the ploughman: the Flemish plough is of later introduction, and the prejudices against anything new are not yet totally overcome. The plough is universally drawn by horses two abreast, driven in reins. Very few ox teams are seen. The land, in general, is not so neatly tilled as in Flanders, Scotland, or the best agricultural counties in England. There is not the same attention to the straightness and equality of the furrows in ploughing. The harrows are triangular, with wooden tines set at an angle of 45°, which may scratch the surface, but cannot penetrate to any depth. A heavy iron drag to tear up the clods, and bring deeply-lying roots to the surface, is much wanted, but is not in use any where, as far as we could observe in a tour through this province. A stone roller is used, set in a triangular frame, which drags on the ground, and serves to break the clods, and is a simple useful instrument, of which we annex a figure. The triangle A B C drags on the ground before the roller, and the horse draws by the hook B. A winnowing machine with a fly and sieves is the only additional instrument in general use.



BRAND, or BURN, is a disease in vegetables by which their leaves and tender bark are partially destroyed as if they had been burnt; hence the name of this disease, which is called *brûlure* in French. It has been observed that after the leaves have been wetted by dews or gentle rains, so that drops adhere to them, and a bright sunshine has succeeded, every spot to which the water had adhered lost its natural colour, and became of a dark or yellow hue; and on closer examination it was found that the organization had been partly destroyed, and that these spots no longer possessed the power inherent in healthy leaves of exhaling water and carbonising the sap which circulates through them. When this disease is extensive and attacks the bark as well as the leaves, it frequently causes the death of the plant, and, at all events, enfeebles its growth, and prevents its perfect fructification. The cause of this, like that of most diseases which are common to plants, has been vulgarly ascribed to some unknown atmospheric influence; and various guesses have been made which, for the most part, have little or no foundation. That which appeared most plausible was, that the drops of water being apparently globular, collected the light of the sun into a focus, and produced a sufficient degree of concentration of the calorific rays to burn the tender substance of the leaves. A little reflection will soon convince us that this will not bear examination. The drops which adhere to the leaves and the bark are not globes, but at best flattened hemispheres, and consequently cannot collect the rays of the sun into a focus on the surface to which they adhere; besides, the spots are as large as the diameter of the drops, so that all the surface that has been covered with water is injured; whereas the focus of a globe, such as would actually burn the leaf, must be very small in proportion to the lens which concentrated the rays. It is much more probable that the effect of the water on the tender epidermis of the leaf or bark to which it adheres is similar to that which it has on vegetable matter infused in it; it softens and dissolves a portion of it, especially when the temperature is somewhat raised, and destroys the vitality; galvanic action may also be excited and increase the effect. It is well known that light is the great agent which produces the change in the sap circulating in the leaves, and that without light the healthy green colour of the leaves and bark, and the peculiar qualities of the descending sap, are not produced. Little or no evaporation takes place from the leaves in the night, and the sudden excitement produced on the whole of the surface of the leaves by the rising sun in a clear morning tends to disorganize those parts to which the water adheres. We do not give this as a perfect and adequate solution of the question, but it appears nearer the truth than any of those more commonly received. (De Candolle, *Physiologie végétale*, vol. iii. chap. iv. s. 2.)

It is a fact that the principal mischief arises from a sudden change of temperature soon after sunrise, especially when there has been a heavy dew or hoar frost in the night; and careful gardeners brush off the drops from their delicate plants before sunrise to guard against the brand. Every drop which falls on the leaves of tender plants from the glass which covers a hotbed in which they grow produces a disease exactly similar to that which we have been describing; and although the vapour of fermenting dung has a pungent ammoniacal smell, it will be found that the water condensed on the glass is nearly pure, and can have no peculiar corroding effect. It acts therefore simply as a dissolvent, and by stopping the evaporation, which is always rapid from the leaves of plants in a hotbed, produces a derangement in their functions, and ultimately disease.

BRAND IN CORN. [BURNT-EAR.]

BREEDING is the art of multiplying the domestic animals rapidly, and at the same time improving their qualities.

Any breed of animals will perpetuate itself provided there is a sufficiency of proper food for them; and the varieties found in a wild state must depend in some degree on the climate and the products of the country in which they are found. Care and domestication also produce varieties, which are much more useful or profitable than the wild breeds; and in the selection of the best individuals to propagate a useful race, and in the rearing of the young, consists the art of the breeder.

Without entering into particulars, which vary with every species of animal, and with the different varieties of the same species, we shall lay down certain principles which experience has proved to be correct, and which being attended to will greatly promote the improvement of all the different animals usually bred for the use of man, whether for his sustenance or for his pleasure. The first thing which is to be kept in view is the chief purpose for which the animal is reared, whether for labour and to assist human strength, or for speed, to convey us rapidly from one place to another;—whether merely for a supply of animal food, or to produce the raw materials of manufacture. In each of these cases distinct qualities are required; and it is seldom that two of these objects can be combined in the greatest perfection.

Having then determined the purpose for which any species of domestic animal is designed, every quality must be attended to which furthers this view; and, except under very peculiar circumstances, the animals intended to keep up the stock by their produce must be chosen with those qualities in the greatest perfection which are essential to the end. In all animals a perfect conformation of the bodily frame is essential to the due performance of the vital functions. The skeleton of the animal should therefore be as perfect as possible. The capacity of the chest, and the healthy nature of the lungs, are points which must never be overlooked, whatever may be the purpose for which the animal is bred; for although a defect may in some measure be counteracted by a judicious choice of the individual coupled with the defective animal, it is only where there is no alternative or choice that any defect in the bodily frame of an animal kept for breeding should be overlooked. In spite of every care the defect will appear in the offspring; sometimes not till after several generations. If it were possible to find individuals without fault or defect, no price would be too great for them; and for those that have been carefully selected for several generations it is real economy to give a very liberal price. In horses bred for racing or for the chace experience has fully proved the truth of this rule; and no one who pretends to breed race-horses would breed from a mare which had a natural defect, or a horse whose whole pedigree was not free from fault. For mere swiftness the shape of the animal, whether horse or greyhound, must combine strength with great activity. The chest must be deep, the lungs free, and the digestive organs sound but small, to add as little weight to the body as is consistent with the healthy functions of nature. The legs should be long and slender, and the bones compact and strong; but the principal thing to be attended to is the courage, and no quality is so hereditary. A horse or hound of a good breed, if in health, will die of exertion sooner than give up the chace. Any defect in courage in an animal intended for great occasional exertion renders him unfit to be selected to continue an improved breed; and whatever may be his pedigree he has degenerated.

With respect to animals whose strength and endurance are their most desirable qualities, a greater compactness of form is required, a greater capacity of the digestive organs, and, according to the climate to which they may be exposed, a more suitable covering. Whether it be to ward off cold or great heat, a thick covering of hair is equally serviceable in both cases. Hardiness of constitution is hereditary, like other qualities; and the manner in which the young are reared tends greatly to confirm or diminish this. An animal of which the breed originally came from a warm climate, like a tender exotic plant, wants artificial warmth for the healthy growth of its limbs; while the indigenous and more hardy breeds may be left exposed to the elements. An abundance of wholesome food and pure water is essential to the healthy state of every animal, as well as exercise proportioned to its strength. These are circumstances which it is obvious must be carefully attended to. There are others, the result of long experience, which are equally necessary to be known, but which are not so obvious. These vary according to the species and variety of the animals bred; and it is seldom that the same breeder is equally successful in rearing different species of animals.

In the animals selected to breed from there are *points*, as they are called, which are peculiar conformations, some of which are connected with the natural formation of the skeleton, and others appear to be the result of an association derived from the known qualities of certain individuals, and of which no very good physiological account can be given. That high withers and a freely-moving shoulder-blade in a horse are connected with his speed is readily perceived, and that the length of the muscles of the quarter, and the manner of their insertion, should affect his power is equally evident; but it is not so apparent that the manner in which the ears are placed on the head, the shape of the nose or jaw, and the insertion of the tail higher or lower, has an important effect on the value of the animal, independently of any arbitrary idea of beauty. A breeder who should not attend to these circumstances in the animals chosen to perpetuate the breed would find, to his cost, that it is more than mere taste which has determined these points. It is the result of observation and experience that certain breeds are invariably distinguished by certain peculiarities, and that these are almost as invariably connected with good qualities, apparently quite independent of the parts on which these points appear.

There is an indication of the disposition of an animal in the eye, in the shape of the head, and in the manner in which it is carried, which seldom deceives an experienced judge. He will not risk introducing a vicious or sulky disposition into his breed, which might counterbalance all the good qualities the animal might possess, and introduce a greater hereditary fault than any imperfection of form.

But nothing is so deceitful as the prejudices which exist with respect to peculiarities and colours. In some countries no ox or cow would be thought good of its kind that was not red or brown without spots; in others a certain portion of white is essential. In Suffolk no cart-horse is prized which is not chestnut; in Northamptonshire he must be black; in Yorkshire brown or bay. This is owing to the common colour of the breeds most esteemed in each county. In Belgium, whence the Suffolk breed originally came, but which has degenerated in its native country, a chestnut horse, with a white mane and tail, as well as a red cow, are despised. Here the reason of the prejudice is the association of the colour with some defect, and those who breed for profit by sale must be ruled by the taste of their customers. The rational mode of proceeding is to be well acquainted with the anatomy of the kind of animal which we make the subject of our attention; to learn by experience what are the peculiar qualities of the different breeds, distinguished by any particular feature, and whether these qualities have any apparent connexion with the peculiarity in make or colour. We may then be guided by the knowledge thus acquired in our choice of individuals, to perpetuate the breed, and not only preserve the useful qualities which they already possess, but gradually improve them. No greater mistake can be committed than that of making what are called violent crosses, such as coupling a very spirited male with a sluggish female, an animal with large bones with one of very slender make, a long-limbed animal with a compact one. By such crosses the first produce has often appeared much improved; but nature is not to be forced, and if the breed is continued, innumerable deformities and defects are certain to follow. The safe way is to choose the animals as nearly alike in their general qualities as possible, taking care that where there is a defect in one it exist not in the other, which would infallibly perpetuate it. A defect can never be remedied by means of another of an opposite kind, but, by great attention, it may be diminished gradually, and at last disappear entirely. This refers however to *defects*, not to peculiar qualities. Cows, for example, may produce either milk or fat in abundance from similar food; and a species of cow which secretes too much fat, so as to be deficient in the milk necessary to rear the calf, may be improved by selecting individuals which give more milk, and by crossing the breed with these; but we must be careful not to choose individuals which differ much in shape from the breed to be improved. A cross between a Herefordshire cow and an Alderney bull might possibly produce a good cow, but the breed of this cow would probably be of inferior quality, whether for fattening or for the dairy, and nothing but ill-formed cows, deficient in milk, and slow-feeding oxen, are likely to result from it. Every attempt to unite opposite qualities is generally attended with a bad result. If a breed has too great an aptitude to fatten, so as to endanger the fecundity of the mother or the health of the offspring, the only remedy is to diminish the food; and if, on the other hand, a difficulty is found in fattening cows which are of a peculiarly good breed for the dairy, such as the Alderney cows and other small breeds, the loss on the old cow sold half fat will have been amply repaid by the milk she has given; and the bull-calves which are not wanted to rear for bulls, if they are not profitable to fatten as oxen, must be fatted off young and sold for veal. But it is not a necessary consequence of an abundant produce of milk, that the cow, when dry, will not fatten readily; although a great propensity to fatten renders the breed less fit for the dairy. The Ayrshire, which are good milkers, fatten well when dry, and the oxen of that breed are as kind feeders as any.

Many breeders have an idea that coupling animals which are nearly allied in blood produces a weak race; others consider it as a prejudice, and among those who held the latter opinion was the famous breeder Bakewell. Without deciding this point, we should recommend avoiding too near a relationship, provided individuals equally perfect can be found of the same breed more distantly related. Every individual has some peculiar defect, and his descendants have a tendency to this defect. If two immediate descendants are coupled, this defect will probably be confirmed, whereas by uniting the descendants of different individuals the defect of either of the parents may never break out; but sooner than retrograde by coupling an inferior animal with one in an improved state, we should not hesitate to risk the consequences supposed to arise from what is called breeding in and in, that is coupling animals nearly related in blood, especially if only on one side, such as the produce of the same male by different females, or of a female by different sires. The qualities which distinguish animals in which the muscles and bones are required to be much exercised, as dogs, horses, and working oxen, are very different from those of animals destined to accumulate mere tender flesh and fat for human food. In the former there must be spirit, activity, and quick digestion; in the latter, indolence and proneness to sleep are advantageous. In the first, the lungs must play with ease, and the muscles be strong, and not encumbered with fat. In the second, the lungs must be sound, as they are essential to all the secretions, and the digestive power must be good, but slow. The food must not be accelerated through the bowels by exercise, but the absorbent vessels of the intestines must draw all the nourishment from the digested food. The more the muscles are impeded with fat, the better the animal will repay the food given him. To choose an animal to breed from, whose produce shall get fat readily, we must attend to this part of the constitution, and care little about spirit and activity. The tendency to secrete bone, and those parts which are called offal by the butchers, as being of inferior value, is a defect. Good flesh and fat are the great objects.

The manner in which the more solid parts of the body are formed, and the greater consumption of food, in proportion to the increase of weight which takes place in young animals, while bones and horns are growing, prove that it is much more expensive to produce bone than flesh, and muscular fibre than fat. Hence it is evident that the greater profit is in fattening animals that have finished their growth; and also that there is a superiority in those breeds which have small bones and no horns. This is an important point to be attended to by a breeder; as is also the time when the bony secretion is completed. A breed of animals that will cease to grow, or have attained their full size of bone at an early age, will be much more profitable to the grazier than one of slower growth. It is in this respect chiefly that certain breeds of sheep and cattle are so far superior to others. The principles which apply to cattle are equally applicable, *mutatis mutandis*, to sheep. In no case are strong bones or horns of much importance to the sheep in its domestic state. The principal objects are wool and flesh, which appear to be dependant on distinct and perhaps incompatible qualities. The attempt to unite the two is perhaps the reason why the Spanish breed, which has been improved when transported into Saxony, has degenerated in England; so that even its crosses are not in repute. It is a matter of mere calculation, whether sheep kept for their wool chiefly are more profitable than those which give an increase of meat at the expense of the quality of the wool. A breeder of sheep who attends only to the quality of the wool will not have his attention taken off from the main object by any deficiency in the carcase, or the disposition of the animal to increase in flesh and fat. It is possible that mixed breeds may be more profitable than the pure. Fine wool may not repay the breeder and rearer of sheep so well as moderate wool and good meat. But the principle we contend for is that of producing the most perfect animal of any one variety existing, by correcting individual defects gradually, and avoiding fanciful crosses, which may destroy in one generation all the advantages obtained in a great many. Hence it is a matter of great importance to consider well the qualities of the individuals with which you begin your improvement, and to know that these qualities have existed in their progenitors, and are not merely accidental. If crossing appear necessary, let it be done very gradually and cautiously. No experienced breeder would ever expect to improve the fleece of a sheep of the Leicester breed or the carcase of the Merino by a direct cross between these two breeds. The offspring would most probably lose all the good qualities for which each breed is noted, and produce a mongrel breed worth little in comparison. But a cross of Merinos with South Downs, or Leicester with Cotswold, might produce new and useful breeds, and these, carefully selected, as has been done, have produced mixed breeds which by great attention may become very valuable.

When it is determined what breed of animals you wish to perpetuate and improve, the individuals which are to be the parents of the stock cannot be too carefully selected. The more nearly they are alike in form, colour, and exterior appearance, the more likely they are to produce a distinct race. They should neither be above nor under the usual size. They should be of such an age as to have entirely ceased growing, and be arrived at perfect maturity; and, whatever may be their good qualities, they should not be selected, if they are the produce of very aged parents, at least on the female side.

In horses and horned cattle many breeders prefer a male rather less in size than the female, and pretend that the fœtus has more room to develop its members in what they term a *roomy* female.* There may be some truth in this, but equality of size, or rather the due proportion established in nature, seems most likely to produce a well-formed offspring. Any considerable deviation from this is generally attended with defect. Nothing is more common than for a country gentleman who has a useful favourite mare, not particularly well bred, when any accident has rendered her unfit for work, to have her covered by some very high-bred stallion, expecting to have a very superior foal. Sometimes this succeeds, but in general it ends in disappointment, especially if the mare be small. A much more certain way is to choose a half-bred stallion, nearly of the size of the mare, and having those good points which the mare already possesses. In this case there is every probability of rearing a well-proportioned and useful animal, instead of a *cross made* one, as the breeders call them, probably from the very circumstance of these *crosses* not succeeding in general. We advert to this as a fact which many of our readers may know from experience.

To give in a few words the rules which result from what we have very briefly stated:—

Choose the kind of animal which you wish to breed from, having distinguishing qualities; keep these constantly in view, and reject all individuals in which they are not as perfect at least as in the parents. Select the most perfect forms, and let the defects be corrected gradually. Have patience and perseverance, and avoid all attempts at any sudden alteration by bold crosses. If possible, breed two or more families of the same kind, keeping them distinct, and only occasionally crossing the one with the other. In this manner a very improved breed may be produced. The nearer you approach to perfection the more difficult will be the selection, and the greater the danger of retrograding. Hence in very highly bred stocks it is often almost impossible to keep up the perfection of the breed, and a fluctuation in the quality of the produce will take place. The more improved the breed is, therefore, the greater attention must be paid in the selection of those which are to continue it. And for want of this, almost every breed, however reputed it may have been at one time, gradually degenerates, and loses its great superiority.

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* See communications to the Board of Agriculture, by Mr. Cline, vol. iv.

As every farmer and occupier of land is more or less a breeder, if he be only a breeder of pigs, these observations may be useful. In the articles on each particular species of animal, these general principles are applied, and more particular directions are given.

BUCKINGHAMSHIRE AGRICULTURE.—The climate of Buckinghamshire is mild and healthy, like that of most of the inland counties in which there are no fens or marshes to engender fevers or endemic diseases. The chalk-hills, which traverse it through its whole breadth from S.W. to N.E., are neither very high nor bleak, and the general temperature is favourable to the ripening of most of the crops usually raised in Great Britain. The hills, which are a portion of the Chiltern range, extending from the borders of Berkshire to Bedfordshire, divide the county into two distinct parts, varying in soil and fertility. To the west lies the fertile Vale of Aylesbury, which contains some of the richest pasture in England, and is a part of the valley of the Thame. Towards the north of this rich tract are some inferior soils; and as you recede from it still farther north, some very poor wet clays and gravels, which require a great outlay to be well cultivated, and return little profit to the farmer. Where they are not under a good system of tillage, which is but too common, they afford little rent, and scarcely a bare existence to the husbandman. They are no doubt capable of improvement; but with low prices for agricultural produce, there is no great inducement to lay out capital on the improvement of poor land.

Towards Bedfordshire there are some light sands partaking of the nature of the sandy belt which crosses that county. On the S.E. of the county the surface is more varied, there being several depressions or valleys on the eastern slope of the chalk, in which some good loams occur. The mixture of chalk with the clay forms a soil well suited to wheat and beans, which, with the help of moderate manuring and good tillage, produces abundant crops. Farther east from the chalk hills are various undulations of the surface, with corresponding variations in the soil: some of the elevations consist of gravel intermixed with clay or loam; others are composed entirely of poor ferruginous sand, and are but partially cultivated, a portion being planted with trees, which seems to be the most advantageous way of disposing of poor sands, on which little will grow except heath. Descending towards the great plain in which the Thames flows, the soil improves greatly; a good loam lying on a gravelly subsoil offers a sound soil for the growth of turnips and barley; and on this land there has been considerable improvement in the mode of cultivation, since many of the old common fields have been inclosed. In the plain which extends along the Thames and to the borders of Middlesex, are some very good and well-cultivated soils. From Marlow to Staines, and for a few miles from the Thames, the cultivation of the land is conducted on good principles, as may be observed all along the great Bath road as far as Maidenhead bridge. The lower lands along the Thames and Coln, which are occasionally flooded, are in permanent meadows and very valuable. The whole of this plain consists of a good loam lying on the blue clay, called the London clay; but with the interposition, in many places, of a stratum of gravel, which adds much to the soundness of the soil above, by forming a natural drain for the waters. The arable land in this part of the county, although much inferior to that in the Vale of Aylesbury, is more carefully cultivated, and the general average return from it is probably fully as great.

According to the estimate made in the Agricultural Report in 1808, the county of Buckingham contains about 393,000 acres of land. Later calculations and measurements of the survey made for the Board of Ordnance make the surface considerably larger. One-half of this is in meadows and pastures, and the other under the plough. The proportion varies according to circumstances. A high price of corn is a temptation to break up grass lands, and low prices induce the farmer to lay down the arable to grass. It is to be regretted that this has often been done inconsiderately; and especially that the lands laid down to grass have been previously exhausted by overcropping, and sown with grass seeds in a foul state, by which great loss has been sustained both by tenant and landlord.

A great many commons and common fields have been inclosed of late years, and considerable improvements have consequently been made; but the progress has not been so rapid of late, owing to the low prices of agricultural produce. The present gross amount of produce in corn, cattle, and from the dairy, which this county sends to the metropolis and surrounding markets, is, however, much greater than it was twenty years ago, and will, no doubt, increase with the increase of capital and skill applied to the cultivation of the soil.

A great advantage to Buckinghamshire, in an agricultural point of view, is the convenience of water carriage by the Thames and by the canals which traverse it in several directions. The Grand Junction enters this county from Hertfordshire not far from Ivinghoe, and runs north to Newport Pagnell, following the valley of the Ousel. Thence it follows the valley of the Ouse till it enters Northamptonshire near Stony Stratford. There are several cuts from this canal in Buckinghamshire; one to the town of Buckingham, another to Wendover, and a third to Aylesbury. The Birmingham Railroad has now extended the accommodations of land carriage.

There was formerly a very inconvenient division of the land in many places, called *yard land;* in the law-books styled *virgata terra.* This somewhat resembled the *run rig and run dale* in Scotland. [BERWICKSHIRE.] It consisted of various narrow and unconnected strips about a pole wide, which, taken together, amounted to thirty or forty acres, and to which certain rights of common were attached. The occupiers were restricted to a certain mode of cultivation highly inconvenient, which was a great obstacle to improvement. Most, perhaps all, of these divisions have been done away with by acts of inclosure.

Much of the land in Buckinghamshire being of a good quality, the farms are not in general very large; few are above 500 acres, and many do not exceed 20 or 30: the average may be taken at about 200 acres. The rent of arable land has fallen greatly of late years, and it might be difficult to state a general average. The poor-rates, till the introduction of the late new laws, were extremely various; and as in taking a farm the poor-rates and tithes are always taken into consideration, and the rent is proportionally less when these charges are high, it is best to include them in the annual value of the land when let. In this manner of reckoning, the farmer pays from 25*s.* to 40*s.* per acre for good arable land, of which the landlord receives from 15*s.* to 30*s.* Meadows let proportionally higher, especially those which are situated along the rivers, and can occasionally be flooded at the option of the occupier. Leases for seven and fourteen years prevail, but most farms are let from year to year; and the tenants are seldom removed, provided they pay their rent and cultivate the land in a proper manner.

The ploughs and instruments of husbandry have been improved since the publication of the Agricultural Report. Although old-fashioned ploughs, drawn by four or even five horses in a line, are still occasionally seen on some of the stiffer soils, they have been considerably superseded by a better implement drawn by fewer horses. In very wet stiff soils the treading of the horses on the land already ploughed is very hurtful; and in those lands it is best to let the horses follow one another in the furrow.

Like the rest of England, Buckinghamshire once contained many common fields, laid out in narrow pieces, or *lands*, which did not admit of cross ploughing, and which were seldom or never straight. By being constantly ploughed towards the middle, these lands became at last so high and rounded, that if a man sat down in the furrow which divided them he could not be seen by another man in the next furrow, owing to the great height of the ridge between them. When these lands were inclosed and laid in regular fields, it took no little trouble to bring them to a regular form. This could only be done gradually; for the best soil being accumulated on the crown of the ridge, would, in levelling, have been buried in the furrows, leaving a barren subsoil exposed where the crown had been. The mode in which the most prudent improvers proceeded was to divide these large lands into smaller, throwing the crown of a narrow stitch into the furrow, or where the *baulk* had been, that is, the narrow strip of ground which was generally left unbroken between the different lands as a boundary to each. Thus the ridge was gradually lowered, and the deep furrow filled up, until the land could be ploughed across the old furrows without much difficulty; after which new and straight ridges could be formed. The occasional application of the spade greatly accelerated the improvement. A few of the old crooked ridges may still be seen on farms where the proprietors or the occupiers dread innovation. The object of high ridges where the soil is wet and impervious, is evidently to let the water run off; but a much better method is to underdrain the land up each furrow, which will take off the superfluous water more effectually. Narrow ridges, properly laid up, will keep any soil sufficiently dry when the underdrains prevent accumulations of water in the furrows. Water-furrows, judiciously deepened with the spade across the ridges, will often take all the water when there are no underdrains. When the lands are laid in a good form they may be kept so by alternately changing the crown and furrow, by which the soil is deepened and the surface kept level.

Buckinghamshire contained, according to the Report, about 150,000 acres of meadows and pastures, the management of which was then, as it is now, superior to that of the arable land. In the dairy districts are extensive pastures, which would be much improved by greater subdivision. Besides the advantage of ditches in draining a soil naturally retentive of moisture, and the shelter given to cattle and sheep by high banks and hedge-rows, it is ascertained that cattle frequently shifted thrive better than when they are kept a long time on the same pasture. In very large pastures there are always spots where the grass is sweeter, and eaten more closely, while in others it is left by the cattle to grow long and rank, and is consequently wasted and trodden down. In smaller divisions or inclosures the whole is more regularly eaten off; and the grass, not being bitten so close to the root, when left untouched for a time by the cattle being removed, grows better and of a finer quality. It is supposed that Buckinghamshire feeds about 20,000 milch cows, each giving on an average 200 lbs. of butter annually. The cows are chiefly short-horns, Glamorgan, and home-bred. On some lands none succeed so well as those which have been reared at home; on others it is said that cows brought from a distance thrive better. May not this be accounted for by the difference in the care with which they are bred and reared? Those who select a good stock to breed from, which experience has shown to suit the quality of the pasture, and keep the calves and heifers well till they come to the pail, will generally find it most advantageous to rear their own stock at home, so that they may be accustomed to the pasture; and, although cows thus reared may be more expensive than cows that are purchased, they will well repay the difference by their greater produce, and general condition when sold or fatted off. But unless great attention be paid to the selection both of the bulls and cows to breed from, the cheapest plan is to purchase cows of a good breed, with their first calf, bred upon land rather inferior in quality to that on which they are to be kept, so that they may not fall off from the change to a worse pasture.

The large Hereford oxen are preferred

for grazing where the land is very good, from the notion that a large ox is more profitable than a smaller. A large ox when fat has, no doubt, more flesh, in proportion to the bone and offal, than a smaller, supposing both equally fat and well-shaped; but it is by no means proved that this flesh is produced by the same proportion of food. A small ox will fatten on inferior pasture, and in a much shorter time than a larger. The return is, therefore, quicker and more certain, and there are experienced men who maintain that a small North Devon or a Scotch highland ox will give a better average profit on his cost and food, in a given time, than the larger breeds. The small Scotch oxen, which fatten so readily in English pastures, always bring the best price in the market, and there is never any difficulty in disposing of them.

Oxen are now much less frequently used in the plough than they were formerly in this county. The greater speed and general usefulness of the horse causes him to be preferred in spite of the pretended economy in the use of oxen.

Hay is the chief food of the cattle in winter, but turnips and straw begin to be substituted, notwithstanding the bad taste which turnips impart to the butter. This taste may be corrected, in some measure, by adding one-third part of warm water to the new milk, and putting a small piece of saltpetre in the cream.

No great quantity of cheese is made in this county, except a few cream cheeses in the neighbourhood of the principal towns. The butter is chiefly sent to London made up in the form of oblong rolls weighing two pounds each. It is sent in baskets called from their shape *flats*, which hold from twenty to forty rolls. Their depth is uniformly eleven inches. Each flat is marked with the initials of the dairyman who sends the butter, and the carrier who conveys it, to whom also the flat belongs; and the quantity contained in each flat is also marked upon it. The factor in London pays the carriage, and remits the amount of the sale once in the month.

In the dairy farms the calves are usually sold, when three or four days old, to dealers, who sell them again to those farmers who, being within a moderate distance from London or any considerable town, find it more profitable to fatten calves by suckling them than to make butter. The calves fatten readily; but to make this business profitable veal should sell by weight at about half the price of butter. It often sells for much more.

Many ewes are kept in this county for the sake of early lambs for the London market. The Dorsetshire ewes, which have lambs very early in the season, are consequently preferred for this purpose. Where mutton is the object, the South Down breed is in greater request. The Gloucestershire and Leicester and a breed crossed between them have lately come into favour, especially since long wool has borne a better price in proportion to the quantity than the shorter and finer. On the Chiltern hills they buy two-thirds of wethers and one-third of ewes in autumn; the wethers are fatted on turnips, and the ewes, after their lambs are fat and sold off, are themselves fatted on grass the next summer.

The horses used for the plough and team are generally large and black; some of them are bred in the county, but most of them are brought when young by dealers from Northamptonshire and Lincolnshire. The largest and finest are frequently resold at six years old to London dealers for dray-horses at a considerable profit. The mode of feeding horses is good and economical. They are soiled in the stable on green-clover or tares in the summer; and in winter they have hay with cut straw and oats.

Hogs are an important appendage to a dairy farm. The favourite breed is the Berkshire, sometimes crossed with foreign breeds, as the Chinese or Neapolitan, or with the Essex and Suffolk breeds. The Neapolitan cross increases the aptitude to fatten, but renders the hog more delicate and susceptible of cold. The Chinese cross gives very delicate small porkers and sucking-pigs. The quantity of pigs now introduced from Ireland has much diminished the profit on breeding this species of stock in this county.

There is a peculiar trade in this county, which is the rearing and fattening of ducks early in the season for the London epicures. The eggs are hatched under hens, and the ducklings are reared in the house with great care. Ducks six weeks old will in January fetch 12*s.* a couple. It is said that ducks to the value of 4000*l.* are sent annually from Aylesbury alone, and 20,000*l.* worth from the whole county.

The value of labour varies in different parts of Buckinghamshire, being generally in the inverse ratio of the poor-rates; from 8*s.* to 12*s.* per week may be considered as the average of wages. No beer or food is allowed except in harvest.

BUCK-WHEAT (*Polygonum fagopyrum*) is said to be found wild in Persia. The cultivation of it, according to some authorities, was introduced into Europe by the crusaders; according to others, the Moors introduced it into Spain from Africa; and hence it has in France the name of *bled sarrasin.* The name of buck-wheat is a corruption of the German buch-weizen, which signifies beech-wheat, from the resemblance of the seed to that of the beech-tree. It is called wheat, because, when ground, it produces a fine farina, which resembles that of wheat in appearance. The botanical name of the genus, Polygonum, is taken from the angular form of the seed, and the specific name, fagopyrum, from its resemblance to beech-mast. Buck-wheat grows with a strong herbaceous, cylindrical, and branching stem of a reddish colour, about two feet high. The leaves, which are ivy-shaped, are placed alternately on the stems. The flowers grow in bunches at the end of the branches, and are succeeded by black angular seeds, formed of four triangles, being thus nearly regular tetrahedrons. The plant is an annual, and the flowers appear very soon after it is out of the ground. They continue to blow and bear seed in succession till the frost destroys the plant. Being a native of a warm climate, the smallest appearance of frost in spring, while the plant is tender, entirely destroys it. Hence it is never sown in northern climates till all danger of frost is over, which in many parts of England is not till the middle of May; but its growth is so rapid, that it may be reaped in September, at which time the principal part of the blossoms will have ripened their seeds. No advantage would be gained by leaving it longer on the ground, for even if the frost did not kill the whole plant, the earliest ripened seeds would be shed and lost; and the last blossoms would not produce perfect seeds.

The cultivation of buck-wheat has never been very extensive in the variable climate of Britain. It is not so well adapted to cold wet soils as to warm sands; nor is it so certain a crop as oats or barley on lands which are suited to the growth of these grains. For countries where there are very poor light lands with a hot dry climate, unfavourable to the growth of oats, and not rich enough for barley, buck-wheat is a great resource; and without it, many tracts of poor land would scarcely be capable of supporting a population. As a principal crop, therefore, it is confined to some parts of the south of France and other countries similar in soil and situation. As a secondary and occasional crop, it often occurs in Switzerland, Germany, and especially in Flanders, where it enters as a regular part of their varied and complicated rotations. Under particular circumstances, it might be introduced with advantage into many parts of England where it is now unknown. The only counties in which it is cultivated to a moderate extent at present are Norfolk and Suffolk, where it is called *brank.* If a small patch of buck-wheat is occasionally met with elsewhere, it is, in general, mainly for the sake of encouraging game, particularly pheasants, which are extremely fond of it.

When buck-wheat is cultivated as a regular part of a rotation, it is generally after the land has been considerably exhausted by former grain crops, and manure cannot be had in sufficient abundance to recruit it. It will produce a better return than oats, and leave the land in a better state, especially in warm and dry seasons. On richer and better soils it may be occasionally a good substitute for barley, when the land cannot be properly cleaned and tilled sufficiently early in spring; for it allows a full month more to prepare the ground; and in this one month, if it be hot and dry, a good tillage may produce nearly all the advantage of a summer fallow. Buck-wheat, on good land, will produce nearly as valuable a crop as barley, though it is certainly more precarious; the seeds sown with it will probably produce more grass or clover than they would if sown with barley; for buck-wheat, sown thin, as it always should be in this case, does not choke the grass, but shelters it from the scorching rays of the sun; and as it draws the land less than any other grain, it leaves it in better heart for the clover. It has been strongly recommended to be sown on good, clean, light land, after winter tares have been either fed off by sheep or cut green for horses. By this means the root weeds, which had been smothered by the tares and ploughed up immediately after the tares were off, will not have time to spring up again; the rapid growth and the shade of the buck-wheat effectually keep them down, and prevent the annual weeds from going to seed. Thus a crop is obtained between the tares and the wheat, and the land is kept perfectly clean. This is mentioned by Arthur Young, in the Survey of Suffolk, as a successful practice, and strongly recommended. Buck-wheat may be ploughed into the ground in a green state. For this purpose it is sown tolerably thick, and when the plant is in its greatest vigour and in full blossom, a roller is passed over the crop to lay it level with the ground. The plough, with the addition of a skim coulter, turns it neatly into the furrows and completely buries it. It soon decays from its own moisture, and the decomposed parts being incorporated with the soil greatly add to its fertility.

On poor sandy reclaimed soils, especially if they are trenched to a considerable depth, buck-wheat may be sown with great advantage for the purpose of being ploughed in as a preparation for the first crop of turnips. The turnips fed off by sheep penned on them will enrich and consolidate the ground sufficiently for a crop of corn or clover and grass seeds. A bushel and a half, or at most two bushels, is an ample allowance of seed for an acre; the cost of it is at most 8*s*. or 10*s*. When buck-wheat is ploughed in for manure, care must be taken to consolidate the surface of the land, if it be light, by rolling or other means, for the decaying stems leave it very loose and hollow: but if the soil is tenacious the air which is let in mellows it and makes it crumble, which is a great advantage. Provided the soil be stirred to a considerable depth, so that the roots of the buck-wheat may strike deep in search of nourishment, however poor or light it may be, or however dry the weather, it will produce a good crop of seed. It only wants a few showers at first, and at the time when the seeds begin to be formed. It continues to put forth blossoms for a long time, and if the first-formed seeds should not be so full as might be wished, the latter may probably make up for it. The careful husbandman must examine the plants at different periods, and reap when he finds the greatest quantity of ripe and full seeds. It is not possible by any management to have all the flowers come to seed in perfection; but under favourable circumstances from four to five quarters of good seed may be obtained from an acre of well-tilled land.

Manure is seldom or never laid upon land in which buck-wheat is sown, because even where manure is abundant it is reserved for other crops supposed to require it more. It is asserted by many that manure makes the buck-wheat run to haulm, and diminishes the crop of seed. That this may be the case, with injudicious additions of dung, we are not inclined to dispute; but if the land was tilled to a sufficient depth, if the manure was well prepared and intimately mixed with the soil, and if the buck-wheat was sown thin in proportion to the richness of the land, we have no doubt that it would not only grow high and strong and blossom well, but would also give an abundant crop of seeds. The reason why crops run to straw and are deficient in corn, when the land is moist and has been highly manured, is that the manure ploughed in and covered only with a few inches of soil excites an extraordinary vegetation in the young green plant, which makes it shoot out a strong vigorous stem; but by the time of flowering the dry weather has exhausted the rich moisture of the manure, and the plant, pushing its roots downwards in search of food, finds a less fertile soil below, out of which it cannot draw the materials to form a full and plump seed. But when a soil is naturally rich, or artificially made so to a considerable depth, a strong and high stem is generally the forerunner of a great bulk of seed, as is often seen in those oats which are scattered thinly among winter tares, the straws of which are like reeds, and the grain, if allowed to ripen, is always both heavy and abundant.

Buck-wheat is sometimes cut in its tender state for soiling cattle. It is said to increase the milk of cows greatly: it is also occasionally pastured by sheep. There is a diversity of opinion on its qualities, some speaking highly of it, and others asserting, and with some appearance of truth, that it is not eaten by sheep or cattle in preference to any other plant, and that it has a stupifying and intoxicating effect when eaten in any great quantity. Upon the whole, we are inclined to think that its value is chiefly as an addition to the variety of plants cultivated for their seeds, and as a cheap vegetable manure.

Buck-wheat may be reaped with the sickle or mown with the scythe, or it may be pulled up by the roots. The latter method is recommended by some, as less likely to shed the seed when fully ripe. In dry weather it is recommended to cut or pull it very early in the morning or late at night, when the dew is on it, and not to move it much in the day. It may be tied up in sheaves or put into small heaps, as is done with peas. In either case birds must be carefully scared away, or they will take a large share of the produce.

Buck-wheat as a grain may be given to horses instead of oats, or mixed with them. No grain seems so eagerly eaten by poultry, or makes them lay eggs so soon and so abundantly. The meal, when it is ground, is excellent for fattening cattle or pigs. The flour is fine and white, but from a deficiency in gluten does not make good fermented bread. It serves well, however, for pastry and cakes: crumpets made of buck-wheat flour eaten with butter are a favourite dainty for children in Holland. A hasty pudding is also made of the flour with water or milk, and eaten with butter or sugar.

On a careful consideration of the reasons for and against a more general cultivation of buck-wheat in our northern climates, it appears to have certain qualities which make it well worth attention. As it belongs to a different natural family in the vegetable kingdom, it is probable that it may be a useful change when the land has been too long cropped with gramineous plants. It may impart to the soil, or abstract from it, some principles by which its power of producing other crops may be increased. This can only be learned with certainty by repeated experiments; but some considerable effect may be expected from the powerful salts which we know are found in the ashes. Its use as a manure is indisputable; the only thing required is an accurate calculation of the comparative expense of its application, with that of bones or any other purchased manure, taking quality and quantity into consideration. A few experiments on an extensive scale, and made with that attention to minute circumstances which is so often neglected in agricultural experiments, and repeated with perseverance, might place the cultivation of buck-wheat in a new point of view.

The result of the analysis of the ashes produced by burning buck-wheat straw as given by Vauquelin is

Carbonate of potash	29·5
Sulphate of potash	3·8
Carbonate of lime	17·5
Carbonate of magnesia	13·5
Silica	16·2
Alumina	10·5
Moisture and loss	9·
	100

These results will no doubt vary according to the soil in which the plants have grown. But the carbonate of potash is so abundant that it has been suggested as a profitable use of the haulm to burn it for the purpose of obtaining this useful salt. This abstraction from the soil, or addition to it in the shape of manure, must produce a considerable effect on the fertility. There is another species of buck-wheat mentioned by some authors as superior to the common, and more deserving of culture in northern climates; it is called the *Polygonum Tartaricum.*

Yuart, in his excellent article 'Succession de Culture,' in the 'Cours Complet d'Agriculture,' Paris, 1820, speaks highly of the Tartarian buck-wheat. It is yellower in the colour, and bears a smaller seed, but is much hardier. Its stubble will remain alive during the winter, grow out in spring, and produce a second crop the next year if let alone; but this does not seem any great advantage, as the second crop is very apt to be overrun with weeds. Yuart mentions a crop grown in the Department de l'Isère which appears extraordinary; 12 measures sown produced 1296 measures, or more than a hundredfold, in a very dry season. Another gentleman obtained 80 for one. Notwithstanding these accounts, Thaer, who has repeatedly tried it, says that 'its produce in a field is so insignificant that he cannot join in its praise.' (vol. iv., s. 162). Perhaps the experiments made in a rich spot in a garden have given results which multiplied produced the above extraordinary returns. Agricultural experiments are unfortunately often made in this way, and consequently give very fallacious results.

BURNT-EAR, in corn, is a disease in which the fructification of the plant is destroyed, and, as it were, burnt up; hence its English name and the corresponding term of *charbon* in French and *brand* in German. Burnt-ear has often been confounded with *smut*, which is a similar but distinct disease. They differ in this, that in the *burnt-ear* the black powder which appears in the ear is external, and the grain has either never been formed, or its coat has been destroyed, so that the whole ear appears black or burnt. The powder also has no smell, and, being easily blown away by the wind, or shaken off in the reaping, little of it adheres to the corn or is mixed with it when ground; and except the loss of so much grain as would have been contained in the sound ears, no great detriment arises to the quality of the corn. The smut, or pepper-brand, on the contrary, is contained in the body of the grain, which retains nearly its natural form, and is carried along with it into the barn. It is only in the threshing or grinding that the diseased grain commonly called smut-ball, is broken, when a fetid black powder is dispersed over the sound grain, which greatly deteriorates the flour, and renders the corn unfit for seed, the disease being perpetuated by this black substance. [UREDO.] Burnt-ears are generally observed in particular moist situations, and some lands are much more subject to them than others. The disease has been often attributed to damp and warm fogs succeeding very dry weather; and hence it has been imagined that it was caused by the dews lodging in the ears and producing a species of rottenness. But microscopic observations have decidedly proved that the black powder consists of the minute germs or seeds of a parasitical mushroom, which are developed in the growing ears, and live on its substance.

The plants attacked by this disease may be distinguished long before the ear makes its appearance out of the sheath in which it is enveloped in its early state. There is a peculiar greenness of the leaf observable; and when the plant is examined, the young ear may already be seen attacked by the disease and beginning to put on a spotted and black appearance, which increases as it grows, and is perfected when the ear arrives at the state in which the flower should appear. In some cases the plant flowers partially or completely, and the fecundation takes place, so that the germ is developed; but it never approaches to maturity. Its outer skin is soon destroyed by the parasitical fungus, and the whole substance converted into a black powder.

De Candolle, one of the best modern authorities on the physiology of plants, has named this peculiar minute mushroom the *Uredo carbo*, which he distinguishes from that which produces the smut, and which he calls *Uredo caries*. They are easily distinguished by the size and smell. The *Uredo carbo* is composed of much smaller globules and destitute of smell; both seem to be propagated like other cryptogamous plants, by means of extremely minute seeds or germs, which are carried along with the sap into the circulation and vegetate in the ear, where alone it appears that they find the conditions necessary to their growth.

Mr. Benedict Prevost has asserted that, having placed the black dust of burnt-ears of wheat in distilled water at the temperature of 10° of the centigrade thermometer (about 50° of Fahrenheit's), he observed that they swelled to twice their original size, and pushed out oblong tubercles, which lengthened to five or six times their diameter, and that they afterwards divided into several branches. After a few days minute grains were observed in the vessels, and the original globules showed an appearance of cells, from which the grains had been ejected. The natural conclusion from this observation, if it be correct, is, that the globules are real bulbs or germs of microscopic mushrooms, which are developed by moisture in favourable situations; and to these the name of *Uredo* has been given, one species being the *Uredo carbo*, which attacks the external parts of the grain, and the other *Uredo caries*, which grows within the grain itself. (See Mr. Benedict Prevost's memoir to the Institute of France in 1807.)

It is doubted by some whether the disease is contagious, because they have never been able to produce it by shaking the black dust of burnt-ears over the sound plants. The reason of this is probably that the exhaling vessels of the surface are not so well calculated to absorb extraneous matter, which can only enter by the spongioles of the roots. Although it is much less dangerous than the smut, because it is readily dispersed by the winds, yet it must more or less infect the soil, and hence the disease is more frequent where it has appeared before, and where those grains which are most subject to the disease, such as wheat, barley, and oats, have been sown in too rapid succession. As it does not adhere to the grain, steeping and washing are not so certain remedies against the infection as in the case of smut; but the best preservative is to drain the land well and keep it in good heart, so that the plants may be vigorous and able to resist the attacks of the parasite: for it is a well-known fact, that weak plants, as well as animals, are much more exposed to the attacks of parasitical plants or animals than those that are vigorous and robust. A judicious change of crops, or a well-established rotation, will in general secure the corn, which is sown in its proper course, from the infection of the *Uredo carbo*, provided the preparation of the land be such as to ensure a healthy vegetation.*

As this disease is extremely common, it has obtained various names in different parts of the country. In England it is best known by the names of blacks, brand, or burnt-ear; and it is often called *smut*, from the supposition that it is a variety of the same disease which attacks the external part of the fructification before the skin of the grain is formed. Whether there may not be some truth in this latter supposition, notwithstanding the opinion before quoted, we do not at present presume to determine.

BUTTER. The preparation of butter is an important part of rural economy. When salted it is extensively used as provision for domestic use and in the victualling of ships, and is a considerable article of commerce. Butter is the fat or oleaginous part of the milk of various animals, principally of the domestic cow. The milk of the cow is composed of three distinct ingredients, the curd, the whey, and the butter; the two first form the largest portion, and the last the most valuable. The comparative value of the milk of different cows, or of the same cows fed on different pastures, is estimated chiefly by the quantity of butter contained in it; and in this respect some breeds of cows are far superior to others. The union of the component parts of milk is chiefly mechanical, as they separate by subsidence according to their specific gravities, the cream being the lightest, and the curd the heaviest; the curd however requires a slight chemical change for its separation from the whey, which at the same time produces a peculiar acid called the lactic acid. From the moment that milk is drawn from the cow it begins to be affected by the air and changes of temperature, and circumstances almost imperceptible to our senses will materially affect its quality. Hence the importance of extreme care and attention in every step of the process of the dairy, especially in making butter.

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* Steeping the seed in brine or stale urine, and drying it with fresh-burnt lime, as is usually done with wheat, is however a useful precaution, which should be adopted also with barley and oats, wherever burnt-ears have appeared in preceding crops: sulphate of copper is said to be more efficacious than common salt.

The cows should be milked in the cool of the morning and evening; they should not be much driven immediately before milking, and it is best to bring them to the place of milking some time before the operation begins. In some situations it is better to milk them in the pastures and carry the milk home; in others to drive the cows gently to the cow-stall. In mountainous countries the first mode is generally adopted, because the cows are apt to leap down steep places, and shake the milk in their udder more than is done by carrying it in the pail. The same practice holds good in Holland from another cause, which is, the distance of the pastures from the home-stall, and the facility of transporting the milk in small boats, all the best pastures being surrounded by small canals communicating with the greater; so that the milk may be carried several miles without the least agitation. In England, where the pastures frequently surround the habitation of the dairyman, the cows are generally driven home twice a day to be milked. As the slightest acidity or putrescence immediately causes an internal chemical action in milk, it is of the greatest importance that the place where the cows are milked, and the persons employed, should be of the greatest purity and cleanliness. The milking-house should be paved with stone or brick, and no litter or dung be permitted to remain in it. It should be washed out twice a day, immediately before each milking; which, besides ensuring cleanliness, produces a refreshing coolness highly useful to the milk. The teats of the cows should be washed clean with water and a sponge. The vessels in which the milk is drawn from the cow should be made of very clean white wood; they should be scalded immediately after having been used, and then exposed to the air, so as to be perfectly dry by the next time of using them. Tin or copper vessels are preferable to wood, because they are not so easily tainted, and are more easily kept clean. Where these are used they should always be kept bright within and without, by which means the least speck of dirt is immediately discovered.

The milk as soon as it is brought into the dairy is strained through a fine sieve or cloth, in order to remove any extraneous matter, and it is then poured into shallow pans, or troughs lined with lead. The best pans are of metal, either of iron carefully tinned, or of brass. Such pans are cool in summer, and in winter allow of the application of heat, which is often very useful to make the cream rise. When leaden troughs are used they are generally fixed to the wall, and have a slight inclination towards one end, where there is a hole with a plug in it, by drawing which the thin milk is allowed to run off slowly, leaving the cream behind, which runs last through the hole into the pan placed under to receive it. The milk in the pans, or troughs, is generally four or five inches in depth, which is found most conducive to the separation of the cream. The place where the milk is set should have a thorough draught of air by means of opposite wire windows. The sun should be carefully excluded by high buildings or trees, and the floor, which should always be of brick or stone, should be continually kept moist in summer, that the evaporation may produce an equal cool temperature. A small stove in winter is a great advantage, provided smoke or smell be most carefully avoided, and the temperature be carefully regulated by a thermometer. All these minutiæ may appear superfluous to those who have no practical knowledge of the dairy, and many dairymen, who cannot deny the truth of what we have stated, may excuse their deviation from these rules by saying that good butter is made without so much care and trouble. This may be true, but they cannot ensure good butter at all times; and when cleanliness and order are brought to a regular system the trouble disappears. It is well known that even the complexion and temperament of a dairy-woman are not a matter of indifference; and that however clean she may be, there are times when the insensible perspiration of her body will have a powerful effect on the milk. In Switzerland men are chiefly employed to milk the cows, and in all the process of the preparation of butter and cheese. The women only clean the utensils, and carry green food to the cows when they are kept in the stable. When the milk has stood twelve hours the finest parts of the cream have risen to the surface, and if they are then taken off by a skimming dish, and immediately churned, a very delicate butter is obtained; but in general it is left twenty-four hours, when the cream is collected by skimming, or the thin milk let off by taking out the plug in the troughs. All the cream is put into a deep earthen jar, which should be glazed, but not with lead: stone ware is the best. More cream is added every day till there is a sufficient quantity to churn, which in moderate dairies is every two days. It is usual to stir the cream often, to encourage a slight acidity, by which the process of churning is accelerated. This acidity is sometimes produced by the addition of vinegar or lemon-juice; but however this may facilitate the conversion of the cream into butter, we would not recommend it, as the quality is decidedly injured by it, especially butter which is to be salted. It has been asserted by some authors that butter will not separate from the butter-milk until acidity is produced, and, no doubt, there is more or less of lactic acid in all butter-milk; but perfectly fresh cream, which has stood only one night, and is churned early next morning, will generally produce excellent butter in a quarter of an hour or twenty minutes in summer, and no acid taste can be discovered in the butter-milk. The change by which the butter is separated in a solid form is accompanied by the development of heat in churning. That the state of the atmosphere with respect to electricity as well as the temperature has a powerful influence on the making of butter, no one can doubt who has paid any attention to the effect of a thunder-storm in a dairy, especially when it occurs at the time of churning. As science becomes gradually applied to all the common arts of life some accurate experiments will probably be made to throw light on this subject, and an electrometer may be found as useful in a dairy as a thermometer is already.

The common method employed to separate the butter from the thinner portion of the cream is by strong agitation. In small quantities this may be done in a bottle; but the common instrument is the *churn*, which is a wooden cask rather wider at bottom than at the top, covered with a round lid with a hole in the centre. Through this hole passes a round stick about four feet long inserted in the centre of a round flat board with holes in it: the diameter of this board is a little less than that of the top of the churn. Various improvements have been made on this machine. The cream should not fill above two-thirds of the churn. By means of this stick, held in both hands, and moved up and down, the cream is violently agitated, passing through the holes in the board and round its edge every time the stick is raised or depressed, and thus every portion is brought into contact with the air. In the course of an hour's churning, more or less according to circumstances, small kernels of butter appear, which are soon united by the pressure of the board against the bottom of the churn, and form a mass of solid butter. The butter is collected with the hand, and placed in a shallow tub for the next operation. The butter-milk is set aside for the pigs, or for domestic use. The butter is still mixed with some portion of buttermilk, but much of its quality for keeping depends on their perfect separation. The most usual way is to spread it thin in a shallow tub, beating it with the hand or a flat wooden spoon, and washing it repeatedly with clear spring water until all milkiness disappears in the water which is poured off. Some experienced dairymen pretend that the butter is deteriorated by much washing, and therefore express the butter-milk by simply beating the butter with the hand, kept cool by frequently dipping it in cold water, or with a moist cloth wrapped in the form of a ball, which soaks up all the butter-milk, and leaves the butter quite dry. This operation requires the greatest attention, especially in warm weather, and no person should work the butter who has not a very cool hand. The less it is handled the better, and therefore a wooden spoon or spatula is much to be preferred.

When it is entirely freed from the butter-milk and of a proper consistency, it is divided into portions of the weight required, if it is to be intended to be sold fresh. The mode of preparing fresh butter for the market is either by making it into *rolls* of two pounds, or into flat round cakes of one pound or half a pound each, which are impressed with some figure cut in a round piece of wood like a large seal, hence called *prints.* The rolls are made oblong with four sides slightly flattened by throwing the lump on a stone or board successively on each of the four sides, and then on the two ends. This requires some dexterity, which is soon acquired, and it is done to avoid unnecessary handling.

To make prints, the butter is first made into balls, and then applied by pressure to the wood, which makes the impressions; the sides are trimmed up along the edge of the wood, and the whole is pressed against a marble or wooden slab, so as to have the impression uppermost, and form a flat cake. The wooden print is readily detached by holding it in the left hand, and giving a smart blow with the right upon it. A hole, bored through the centre, prevents the adhesion of the butter from the exclusion of the air. In Cambridgeshire butter is made up into rolls a yard long, and passed through a ring of a certain diameter, for the convenience of dividing it into small portions without the trouble of weighing. Hence the butter is said to be sold by the yard.

The greatest portion of the butter that is made, especially at a distance from large towns, is immediately salted and put into casks, which usually contain fifty-six pounds, and are called firkins. The quality of the salt used is of great importance; if it be pure, the butter will keep its flavour for a long time, but when it is impure and contains bitter and deliquescent salts the butter soon becomes rancid. The Dutch are very particular in this point. They use a kind of salt which is made by slow evaporation, and perfectly crystallized. The salt is intimately mixed with the butter. From three to five pounds are sufficient for a firkin of fifty-six pounds.* The casks are made of clean white wood. They are carefully washed inside with strong brine made hot, and rubbed over with salt. The butter, being quite dry, is pressed close into the cask, a small layer of salt having been first put on the bottom. Every addition is carefully incorporated with the preceding portion. If there is not a sufficient quantity to fill the cask at once, the surface is made smooth, some salt is put over it, and a cloth is pressed close upon it to exclude the air. When the remainder is added, at the next churning, the cloth is taken off, and the salt, which had been put on the surface, carefully removed with a spoon. The surface is dug into with a small wooden spade, and laid rough, and the newly-salted butter is added and incorporated completely. This prevents a streak, which would otherwise appear at the place where the two portions joined. When the cask is full, some salt is put over it, and the head is put in. If the butter was well freed from all the butter-milk, and the salt mixed with it quite dry, it will not shrink in the cask, and it will keep its flavour for a long time. Should there be an appearance of shrinking, the cask must be opened, and melted butter poured round it so as to fill up the interstices between the butter and the cask; in this way it will not suffer in its quality. There is a mode of preserving butter for domestic use without salt, in the following manner:—the butter is set in a clean pan over the fire and melted very gently; it is not allowed to boil, but is heated very nearly to the boiling-point. Experience has shown this heat to be attained when the reflection of the white of the eye is distinctly seen on the surface of the butter on looking down into the pan. All the watery particles are then evaporated, and the curd, of which a portion always remains in the butter, and which is one cause of its becoming rancid, falls to the bottom. The clear butter is poured into an earthen vessel, and covered over with paper; and a bladder or a piece of leather is tied over the jar to exclude the air. When it is cooled it much resembles hog's lard. It has lost some of its flavour, but it is much superior to salt butter for culinary purposes, and especially for pastry.

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* The following mixture has been found superior to salt alone in curing butter:—half an ounce of dry salt pounded fine, two drams of sugar, and two drams of saltpetre, for every pound of butter.

The Devonshire method of making butter differs materially from the common process which we have described, and is peculiar to that county. The milk, instead of being set for the cream to rise, is placed in tin or earthen pans, holding about eleven or twelve quarts each. Twelve hours after milking these pans are placed on a broad iron plate, heated by a small furnace. The milk is not allowed to boil, but a thick scum rises to the surface. As soon as small bubbles begin to appear where a portion of this is removed with a spoon, the milk is taken off and allowed to cool. The thick part is taken off the surface, and this is called *clouted cream.* It is a sweet pleasant substance, more solid than cream, but not so solid as butter; and is considered as a dainty by all those who have been early accustomed to it. A very slight agitation converts it into real butter; after which it is treated exactly as we have before described. It does not appear that there is any peculiar advantage in the Devonshire method.

Another method of making butter, which is more generally adopted, is to churn the milk and cream together. This method is pursued in parts of Holland, Scotland, and Ireland, and is said to produce a greater abundance of butter from the same quantity of milk. In the Dutch method the milk is put into deep jars in a cool place, each *meal,* or portion milked at one time, being kept separate. As soon as there is a slight appearance of acidity the whole is churned in an upright churn, which, from the quantity of milk, is of very large dimensions. The plunger is therefore worked by machinery moved by a horse, or sometimes by a dog walking in a wheel, which he turns by his weight. When the butter begins to form into small kernels, the contents of the churn are emptied on a sieve, which lets the butter-milk pass through. The butter is then formed into a mass, as described before. In Ireland the process is very similar, but the milk is allowed to arrive at a greater degree of acidity, which is a defect.

In Scotland the following method is pursued:—the milk is allowed to cool for six hours, and then put into a clean vat. As long as it remains sweet, more milk may be added, but not after any acidity is produced. It is then covered and allowed to get sour, till it coagulates at the top; this coagulum is called the *lapper,* which must not be broken till the butter is churned. When the clotted milk is put into the churn, warm water is added so as to raise the temperature to 70° or 80°, the whole being gradually stirred in. When this is properly conducted, the butter-milk will be very pleasant and wholesome, with a sub-acid taste, the serum and curd not being separated from each other for some time after. The butter is said to be fully equal to that made from cream alone. (*Quarterly Journal of Agriculture,* Dec. 1834.)

Butter is a most valuable article of commerce, and a great source of wealth to those nations which produce it in the greatest perfection. The Dutch have hitherto had the pre-eminence: but there is no good reason why the rich pastures in England and Ireland should not produce as good butter as those of Holland, if sufficient attention were paid to the minutiæ of the dairy, to the purity of the salt used, and especially to cleanliness, for which the Dutch are so remarkable. The quality of the butter depends on some very minute circumstances, which escape the notice of all superficial observers. The smallest particle of putrescent matter, accidentally added, and even mere effluvia, give a turn to the chemical action going on from the moment the milk is exposed to the air, and they taint the cream more or less. The quantity of pure cream which rises when the milk is set in the pans, as well as its quality, is influenced by these circumstances. When the milk curdles before the cream is separated, it is almost impossible to prevent some portion of the curd being mixed with the butter. In its perfectly fresh state the taste is not affected by this; but the butter will not keep fresh above twenty-four hours, and when salted soon becomes rancid. Thus a greater quantity is produced, but of inferior quality. When cheese is made of the milk from which the cream has been taken, it will be found most profitable not to attempt to take off all the cream by repeated skimming; for more will be gained in the better quality of the cheese, than by an increase in the quantity of the butter, at the expense of the quality.

It is an acknowledged fact, that such are the niceties of the dairy, that great experience alone can ensure a produce of superior quality, and this experience would be more readily acquired if the circumstances were accurately observed and noted. We would recommend to those who have extensive dairies to mark by the thermometer the temperature of the milk and cream in the different stages of the process; occasionally to test the acidity of the butter-milk by means of alkalies; and to note any peculiarity in the atmosphere by an electrometer. A few observations carefully noted, repeated, and compared, would throw more light on the true causes which favour or oppose the production of good butter, than all the guesses that have hitherto been made.

The quality of the butter depends materially on the nature of the pasture. The best is made from cows fed in rich natural meadows. Certain plants which grow in poor and marshy soils give a disagreeable taste to the butter. The common notion that the yellow flower called the butter-cup gives colour and flavour to butter is a mistake: cows never crop the flower if they can avoid it, and the whole plant is acrid and unpalatable. When cows are fed with cut grass in the stable, the butter is inferior, except in the case of some artificial grasses, such as lucerne. Turnips and other roots given to cows in winter communicate more or less of a bad taste to butter, which is corrected in some degree by means of a small quantity of water and saltpetre added to the milk; and also, it is said, by giving salt to the cows with their food. But there is no butter made in winter equal to that which is made where the cows are fed entirely with good meadow hay, especially of the second crop, called aftermath hay, which contains few seed-stalks. [AFTERMATH.]

The yellow colour of fine May butter is frequently imitated artificially by mixing some ground annotta-root, or the juice of carrots, with the cream. This is easily detected by the taste of the butter, which is not improved by it, and has not the peculiar flavour of fine grass butter; but in other respects it is a harmless addition. Some cows give a much yellower cream than others, especially the Alderney cows; and the butter made from it is of a peculiarly fine flavour. When a cow has lately calved, the milk is also much yellower, but this soon goes off, if it be not the natural colour; and the butter made by mixing this with other milk, although of a deeper colour, is not improved by it.

According to the accounts of the produce of butter from different countries and various breeds of cows, we may state that, on an average, four gallons of milk produce sixteen ounces of butter; and to make the feeding of cows for the dairy a profitable employment in England, a good cow should produce six pounds of butter per week in summer, and half that quantity in winter, allowing from six weeks to two months for her being dry before calving; that is, 120 lbs. in twenty weeks after calving, and 80 lbs. in the remainder of the time till she goes dry,—in all about 200 lbs. in the year. If she produces more, she may be considered as a superior cow; if less, she is below par. To produce this quantity the pasture must be good; and if we allow three acres to keep a cow in grass and hay for a year, which is not very far from the mark, the butter made will produce about 10*l.*, at the distance of fifty miles from London, if it is sold in a fresh state, and the calf about 15*s.* at a week old. This does little more than pay rent and expenses; the profit must be made by feeding pigs, or making skim-milk cheese.

An inferior kind of butter is made in some cheese dairies from the oily portion of the milk skimmed from the whey, which is set in pans like milk after the cheese has been made. It is sold at an inferior price to labourers, and seldom comes to market. It is totally unfit for salting and keeping. It is known by the name of *whey butter.*

CABBAGE. There are several species of the genus *brassica,* or cabbage, which comprehends the *turnip,* the *rape,* the *cole,* and the common culinary cabbage, or *brassica oleracea.* The innumerable varieties arise from difference of soil and cultivation; and as all the cabbage tribe form hybrids, new varieties are continually produced. This is effected by the bees, when different sorts are in flower at the same time. The pollen adheres to their body as they seek honey in the flowers, and being deposited on the pistils of other sorts, impregnates the germen. Hence only one variety of cabbage should be in flower at the same time in any garden or field, when we wish to keep the sort unadulterated; particularly if some sorts have expanded leaves and others close heads. It is thus only that the excellent small miniature cabbage, which grows on the stem of the Brussels sprout, can be kept in perfection. The different sorts of cabbages most prized for the garden are chiefly divided into the close-hearting and the spreading. Of the first, the York and the Savoys are the most common; of the latter, the coleworts and Scotch kale.

In order to have a regular succession of cabbages the seed should be sown at different times, from the beginning of spring to the autumn. The early sown will run to seed the same year; the later sown will increase more, produce larger and firmer heads, and will not go to seed till the next season. Some sorts, it is said, will continue to produce leaves for several years, if they are regularly taken off, and if the seed stem is prevented from shooting by cutting it down as soon as it begins to appear. Thus a perennial cabbage-tree is produced, which yields abundance of food for sheep and cattle.

Cabbage plants are generally raised first in a seed-bed; when they are intended for early produce they are sown before winter, and protected by shelter, or under glass frames. In this manner strong plants may be had early in spring, which planted out in April will produce fine cabbages by July or August. Those which are raised on a large scale are generally sown in March, and planted where they are to remain in June or July. When they have been picked out from the seed-bed very young, and allowed to get to a good size in a piece of ground prepared for the purpose before being finally transplanted in the field, the success is more certain, and it will well repay the additional trouble. These come to perfection in autumn, and may be taken off the ground as they are wanted. Some kinds are so hardy that they will bear the severest frosts, and remain covered with snow for a considerable time without damage. Such are the green curly-leaved cabbages, or Scotch kale, which form no close head, but consist of spreading leaves. The great portion of nutritive matter in the leaves and stems of cabbages has made them an important object of cultivation wherever much cattle is kept, and where the land is favourable to their growth.

The cultivation of cabbages is the same in the field as in the garden, except that on a large scale less attention is paid to each plant, and the spade is superseded by the plough and other instruments. A good and rather stiff loam is best adapted to cabbages. They require a considerable portion of manure if the land is not naturally rich, or if they are cultivated as a part of a regular rotation. There is no vegetable which produces so large a portion of food for cattle on the same space as the cabbage, provided the soil suits its growth. Though it impoverishes the ground, this should not prevent its being extensively cultivated, provided the nourishment it produces compensates for the additional manure required. The great advantage in the cultivation of the cabbage is, that a great portion of its substance is restored to the ground in all well-regulated farming establishments, in the shape of the dung and urine of the cattle fed upon them. It is asserted by experienced agriculturists that in this respect it is superior to the common turnip. The cultivation of the cabbage on a large scale is by no means so general on the soils well adapted to them as might be wished. This is probably owing to the trouble of transplanting, and the occasional failure of the plants in very dry weather. But the trouble and expense may be greatly diminished by attention and method. The plants may be raised in such abundance, by having a regular garden for the purpose, that they may be transplanted at various times, and the plants placed so thick as to allow for failures, whilst those which are superfluous may be hoed out. The cause of failure is generally in the careless manner of planting. Holes are usually made in the ground with some blunt instrument, the plants are put in without its being noticed whether the roots are doubled up or straight, whether the earth is pressed close to the roots, or vacancies are left between them and the soil, in which case they cannot take root properly. The ground having been well prepared, and being in good heart and tilth, the plough should open a deep and narrow furrow. The plants having been carefully taken up without breaking the fibres of the root, the tops should be cut off to about six inches from the crown, women and children should then go along the furrow with baskets in which the plants are carefully laid, and place them, at the distance of eighteen inches or two feet from each other, against the earth which has been just turned over by the plough, so that the bottom of the roots shall lie along the newly-made ridge, and the crown of the plant be on a level with the surface of the ground; a slight push will make it adhere to the fresh soil. If some rich mould is mixed with drainings of the dung-hill or ditch-water to the consistency of soft mud, and the root of each plant is dipped in a pail of this mixture immediately before planting, the plants will seldom fail. The plough in returning covers all these roots with the earth of the next furrow; and a man follows and presses his foot obliquely against the furrow slice at the place where the head of the plant appears. The plough then takes two shallower and broader furrows, or leaves a space of two feet between the last-made furrow, and forms another in which plants are again placed and covered up as before. The rows will thus be three feet wide. If the cabbages are of a large sort, every alternate plant may afterwards be cut off, either as soon as they are fairly rooted, or when they have acquired a moderate size; in which case they will afford excellent food for cows and pigs, although not sufficient to stall cattle upon. The repeated use of the plough and horse-hoe between the rows is necessary for the growth of the cabbages, as well as highly useful to clean the land. By this mode of cultivation much labour is saved, the risk of the failure of the plants is greatly diminished, and if the ground has been well prepared and sufficiently manured, an astonishing weight of solid food for cattle is obtained. The best sort to plant in the field is the large red or the Scotch drum-head cabbage. Should the ground be of great fertility, and at the same time compact, the large Strasburg cabbage, which grows to the weight of 60 and even 80 lbs., will produce an enormous weight of food. This cabbage is common in Germany.

When given to cattle or sheep, cabbages should be sliced in the same manner as turnips or beet-root. When milch cows are fed with them, all the decayed leaves should be carefully taken off and given to store cattle or pigs; for these are the chief cause of the bad taste which the milk and butter acquire from this food. [Butter.] For bullocks cabbages and oil-cake are excellent food, and increase their flesh rapidly. For sheep they should be sliced and given to them in troughs in the field where the cabbages grow, or on grass-land which requires to be manured. In England the sorts which have a close head are preferred; but where labour is abundant and forage scarce, as in France, the branching sorts are thought more profitable, because the leaves may be taken off repeatedly and will grow again. The thousand-headed cabbage, and the large cabbage of Poitou, as well as the tall cabbage, called *chou cavalier*, which grows with a stem six feet high, and gives large broad leaves without any close head, are greatly preferred in France to the sorts which bear close heads.

Cabbages are subject to a peculiar disease when repeatedly planted in the same ground; the bottom of the stem enlarges, and the plant becomes sickly. This disease is called *clubbing*, and is occasioned by an insect, which deposits its eggs in the substance of the stem where it joins the root: the organization of the plant is deranged, and the cabbages never come to perfection. The only remedy for this disease is to change the cultivation, and for a time to plant no cabbages on the ground which produces clubbed plants, but to trench it up well, and expose it to the winter's frost in ridges: quick-lime should be put on it, but no manure; and other vegetables of a different class should be sown for two or three years. After this it may be considered as purified, and cabbages may safely be planted there again. In the fields, where the cabbages do not return so frequently on the same ground, this disease is seldom found. The depredations of caterpillars and slugs are sometimes very great; the only means of prevention is to pick them off as soon as they appear: ducks and fowls in this case are excellent helps, the former especially, for clearing the ground of slugs.

In Germany there is an immense consumption of the large white cabbage in the form of the national mess called *saur kraut*. This is prepared in the following manner:—the cabbages are sliced thin by hand, or by a machine like a turnip-slicer, of the same kind as that by which French beans are sliced in Holland. [BEAN.] The bottom of a cask, of which the head has been taken out, is covered with salt, and a layer of thin-sliced cabbage six inches thick is laid over it; on this a quantity of salt is spread, and another layer of cabbage mixed with some juniper-berries and whole pepper; and thus salt and cabbage alternately until the cask is filled. A round board is then put into the cask so as nearly to fill it, and on this a heavy weight of stone or metal is laid. As the cabbage ferments and sinks, the cask is filled up with fresh salt and cabbage. After some time the expressed juice is poured off, some water with salt dissolved in it is poured over, and changed until it ceases to rise with a scum and fœtid smell; the cabbage is then in a fit state to be kept. A cloth is laid over it, and over this the round board and weights. When any portion is taken out for use, a sufficient portion of brine is allowed to remain over the mass to exclude the air; and the cloth, board, and weights are replaced as long as any cabbage remains. This *saur kraut*, when washed with soft water and stewed with bacon or salted meat, is a very wholesome dish, and much relished by those who have been early accustomed to it. In long voyages it has been found to be an admirable preservative against the sea-scurvy.

CALF. The rearing and fattening of calves is a very important part of rural economy, and on the care with which this is done depends much of the profit of grass-land in particular situations. In the dairy districts the milk is so valuable, that calves are got rid of as soon as possible. In some countries they are killed when only a few days old, and the flesh is of little value, being very soft and tasteless. In others the flesh of very young calves is considered unwholesome, and penalties have been imposed on those who kill a calf before a certain age. This is the case in France and Switzerland, where ten days is the earliest time at which a calf is permitted to be killed for sale.

Wealth and luxury have introduced a very different mode of proceeding in England. Calves are suckled with great care, and allowed to take as much milk as they can swallow, in order to make them fat, and their flesh white, firm, and delicate. The price at which a fat calf is sold, when ten or twelve weeks old, is often much greater than he would fetch at twelve months if reared in the common way. It is chiefly in the neighbourhood of large towns that the practice of fattening calves is profitable. The calf-dealer buys calves in the dairy districts, and sells them again to those who suckle them. The animals are carried to a great distance in carts made purposely flat and shallow, their four feet tied firmly together, and their heads hanging over the back and sides of the cart. In this position they remain whole days without food or drink, and when they arrive at the place of sale they are so weak and attenuated that many of them die; and all of them require the greatest care and attention for several days before they recover sufficient strength to bear their natural food. If they are allowed to satisfy their appetite at first, they invariably *scour*, that is, purge violently, and die. If the strong astringent medicine sold in the shops for the scouring in calves is given to them in this weak state, it only accelerates their death. The best remedy is to boil the milk for them, and give them little at first; to mix some starch or arrow-root with it, and to give them a raw egg beat up in milk. This restores the strength of the stomach, and generally cures them. When the calf begins to thrive on the milk which he sucks, or which is given him warm from the cow, nothing more is necessary than to keep him extremely clean and dry, to give him plenty of air, but not much light, and never to disturb him between his meals, which are generally twice in the day, at the usual time of milking the cows. Where it can be conveniently done, it is better to let them suck three times a day. If one cow does not give sufficient milk to satisfy the calf when he begins to get large, another cow must be at hand. Where a number of calves are fattened at once, and no butter or cheese is made, the number and age of the calves must be regulated by the number of cows and the quantity of milk which they give, so that there shall be milk enough for all.

The calf-pens should be made like narrow stalls, each for the accommodation of only one calf, just wide enough to allow him to lie down, but not to turn about and lick himself, which, if it become a habit, will much retard his progress in fattening. The bottom of the pen should be paved with brick, and washed clean morning and evening—or it should be boarded; the boards should be six inches from the ground, and have holes bored in them to let the urine drain through. A piece of chalk or powdered limestone is frequently put in a small trough, which the calf licks, and thus corrects the acidity which is apt to be generated in the stomach. The common notion that it makes the flesh whiter is a mistake, except so far as good health in the calf produces whiter flesh. When the calves are taken out of their stalls to suck the cows, they must not be allowed to play instead of sucking. If they appear not to have much appetite, a little salt may be rubbed into their mouth, and they may occasionally have a raw egg put down their throat. At five or six weeks old, if a little sweet hay is tied in a small bundle with a string and hung before them, they will pick a little of it; and by thus exciting the saliva the digestion will be assisted. It is only by minute attention that the suckling of calves can be made more profitable than the making of butter or cheese. When it is well managed, and the price of veal is about one-half the price of butter by the pound, there is an advantage in suckling, but otherwise making butter is more profitable.

Calves should be fat by eight or nine weeks old, and it is seldom advisable to keep them above twelve weeks. When they get large they take a much greater quantity of milk, in comparison with what they do at seven or eight weeks old, to produce the same increase of flesh. A calf of 16 or 18 stones (eight pounds to the stone) the four quarters, and well fatted, will always sell better than one that is larger.

When milk is scarce, and the calves have not enough to satisfy them, it may be necessary to give them some substitute, such as meal mixed with warm milk, or balls of meal and water with a little gin in them, which makes them drowsy. Linseed made into a jelly with boiling water and mixed with warm milk is given by some, or powdered oil-cake. All these substitutes can only be recommended when the milk fails—they deteriorate the flesh more or less. The best plan, in such a case, is to sell the largest calves and reduce the number, so that they may all have their fill of milk. To know the weight of the four quarters of a calf when killed, take the live weight and multiply it by 0·6. Thus if a live calf weighs 200 pounds, his four quarters when he is killed will weigh 200 × 0·6 = 120 pounds.

When calves are intended to be reared for grazing or for the dairy, the most perfect individuals should be chosen. They should be well examined, especially the cow calves, to ascertain whether they have a perfect udder and teats, a broad pelvis, and good lungs. If any deficiency appears, they ought to be sold or fattened. They should be allowed to suck the mother three or four days, but no more, and then be taught to drink milk out of a pail.—This is soon accomplished by gentleness and care. Should there be any difficulty in teaching him to suck with the hand in the usual way, a wisp of twisted straw is put into the pail and one end of it in his mouth. This seldom fails to bring him to drink. When the calf is a week old, skimmed milk which has been boiled and allowed to cool again, so as to be milk-warm, may be given him. After a time this may be diluted with water, and a little meal stirred into it; or some thin gruel may be made to which skimmed milk is added. Carrots or turnips make an excellent food for calves, especially if they are boiled with cut hay and given warm. In this way calves may be reared with very little milk, till they can live on grass alone. A bull-calf not intended to be kept as a bull may be castrated when three months old.

The diseases of calves are chiefly *scouring* and *constipation;* for the first, if the calves are strong, the following recipe is recommended by Clater, and appears likely to remove the complaint:—prepared chalk four ounces, crabs' eyes two ounces, white powder of burnt bones two ounces. These ingredients are pulverized and well mixed, and a large tablespoonful of the powder is given in a pint of new milk every night and morning before the calf is fed, until the purging ceases. For costiveness the following is a good and safe remedy:—castor-oil one ounce, prepared kali half a drachm, ginger in powder one tea-spoonful. Mix these for a dose, and give it in half a pint of warm milk.

CAMBRIDGESHIRE AGRICULTURE, &c.—The soil of this county is extremely various, consisting of clay, loam, and chalk, both in the uplands and the fens. Although there are some poor commons and heaths, the greater part of the land is fertile. In some spots called white land, which have chalky subsoils, great crops of wheat and beans are raised. The Burwell wheat is in great request for seed in many parts of England, and the cheeses of Cottenham indicate considerable richness in the pastures. The climate in the uplands is mild and healthy, but in the fens, especially those which have not been thoroughly drained, agues and fevers prevail when the water has evaporated and left the land in a half-dry state. When the land is quite flooded, the air is less impregnated with unhealthy effluvia. In proportion as the fens are drained and the land is cultivated, the air becomes more healthy.

The upland district is sufficiently varied to afford good situations for residences; but until the beginning of this century a very small proportion of the land was inclosed. Above three-fourths of the surface was occupied by commons, common-fields, heaths, and fens. Of these many have been inclosed within the last thirty years; and in the course of time the whole face of the country will be much improved by the growth of trees and hedge-rows. There are few counties where so many inclosures have taken place under special acts of Parliament. The villages were mostly situated in hollows, between gentle elevations, where the soil was naturally most fertile; and being scattered through an open country, with their small inclosures and orchards, presented insulated green spots, which formed a strong contrast with the surrounding open fields entirely destitute of trees. The fen district is a dead flat intersected with ditches, canals, and sluggish streams. The soil consists of mud mixed with decayed and half-decayed vegetable matter. When the superfluous water has been removed, a soft spongy surface is left, which is much improved by burning. The ashes thus produced, by being mixed with the soil greatly enrich it, and the most luxuriant crops are obtained without any other preparation. When a judicious rotation is adopted, and the ground is not too much exhausted to be restored by proper manures, this land, which is reclaimed from a state of comparative unproductiveness, becomes very valuable. But the temptation of immediate profit frequently induces the farmer to raise exhausting crops from it, as long as they will grow without fresh manuring, by which means the soil is so impoverished, and its *staple** so reduced, that subsequent tillage or manuring cannot recruit it for a very long time.

The first operation on a newly-inclosed fen, when it has been drained, is to pare the surface, on which coarse grass and sedge are growing in a matted state. The sods are cut about three inches in thickness and of various lengths and breadths, by means of a paring-plough. This is a sharp instrument drawn by two horses, which cuts horizontally under the surface, and is guided by two handles like a plough. The sods being set on edge, to dry partially, are then arranged in the form of a small kiln with proper air-vents, and lighted by means of brush-wood or straw. As soon as they begin to flame more sods are added, and the fire is prevented from breaking out by immediately covering with a sod every place from which the smoke issues strongly. In a short time a great quantity of sods is reduced to a carbonized mass, which, when cool, is spread over the ground. This is immediately ploughed in, and the land is sown with cole-seed or rape, of which an abundant crop is invariably produced. The cole is fed off with sheep, the land ploughed once, and oats are sown, which produce astonishing crops. This is succeeded by wheat, or sometimes by another crop of oats, in which are sown clover and grass seeds, which soon cover the ground with fine herbage. The land is left in grass as long as the grass is good. As soon as it begins to decline in quality or produce, it is ploughed up and sown with oats, or it is again pared and burnt as before. The most common practice, however, when the soil is very rich, is to take crops of cole-seed, wheat, barley, and oats, and not to sow grass seeds till after several crops have been obtained, taking care however to keep the land clean. The soil of newly-drained fens is very loose, and requires to be compressed after the seed is sown. This is sometimes done by men treading the ground with their feet, or by driving sheep over it; but the land-presser. [ARABLE LAND.] is particularly adapted to this purpose. It not only consolidates the land, but forms drills for the reception of the seed. The grasses usually sown with the last crop of barley or oats are, of rye-grass two bushels and of white clover ten pounds. Where the land is cultivated with care, the use of rape-cake as manure is common. It has the advantage of being readily brought from a distance: 1000 cakes weigh about a ton, and are sufficient for three acres. The rape-cake is ground to a powder, which is drilled with the seed by a machine. It ensures a crop of corn on land which has been exhausted, and in this way it is a matter of simple calculation whether it repays the expense. But the most advantageous mode of using it is to sow it with cole or turnip-seed, and to feed off the crop with sheep: permanent improvement of the soil is thus produced, and the land is recruited for several crops.

Besides corn and hay, the fens, where they have not been brought into cultivation, produce turf for fuel, and reeds and sedges for thatching and lighting fires. An acre of ground will produce 300,000 turves, 5000 of which are considered to be equal to forty bushels of coals. The price varies from six shillings to ten shillings per thousand, according to the situation and comparative price of coals. Osier-beds are likewise formed in some places, and give a good return.

In the uplands towards Hertfordshire and Suffolk the land was formerly cultivated on the old three-field system; and there are still farms where a summer fallow is regularly succeeded by wheat or barley, and that by oats, with the occasional introduction of clover or beans. But where a better system has been adopted after the inclosure of the common fields, turnips form the foundation of the course on all lands which are sufficiently dry to allow sheep to be penned on them. On some stiff clays cabbages have been introduced, and cultivated to some extent. The large red cabbage is preferred by many to the drum-head, because it is not so liable to be attacked by caterpillars.

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* The staple of a soil is a peculiar quality, on which depends its power of nourishing the roots of plants and conveying to them those particles on which their growth and health depend.

They manure the land for this crop with twenty or thirty good loads of farm-yard dung per acre, and find the produce very valuable for cattle and sheep in winter. In the rich white land, wheat and beans are sown alternately, as long as the land is clean; and if the beans are drilled and well hoed, and the land moderately manured for this crop, this simple and profitable rotation may go on for a considerable time.

By the introduction of sainfoin on some of the thin chalky lands, a soil naturally very unproductive now supports a great quantity of cattle and sheep, and also bears good crops of corn after having been some years in grass.

There is a great portion of the stiff heavy lands in Cambridgeshire, independently of the fens, which would be greatly benefited by judicious surface-draining. By this means, many soils now too wet to bear turnips, or to allow heavy cattle to be depastured upon them in spring or autumn, would become dry and sound; and the water being carried off by the drains, would not stagnate below the surface and keep the ground in a soft state, equally prejudicial to the growth of all plants not usually found in marshes, and to the cattle and sheep depastured on them. A convertible husbandry might then be introduced, the expenses of cultivation much diminished, and the produce greatly increased.

CANARY GRASS (*Phalaris Canariensis*) is an annual grass, cultivated for its seeds, with which tame birds are fed, especially canary birds. The consumption of this seed is so considerable as to make it an article of commerce. Canary seed is chiefly cultivated in the Isle of Thanet in Kent, and about Sandwich. It requires a good soil, neither too light nor too wet, and an open country, without many hedge-rows; for small birds are so fond of the seed, that where they abound it is scarcely possible to protect the crop from their depredations. The plant grows like a strong grass, with an oval spike at the extremity of the stem. The seeds are closely enveloped by a strong chaff or husk, from which they are not easily separated; they are oval and pointed at both ends, and of a bright straw colour. The kernel of the seed is pleasant to the taste, and has the flavour of nuts.

Canary grass has been tried in a green state for cattle; but besides the price of the seed, which is high compared with that of other grasses, it has not been found sufficiently abundant or nutritious to make it preferable to any of the grasses usually cultivated for that purpose. When sown for the seed it is best sown in drills, at the distance of eight or nine inches from each other; this admits of hoeing, by which the quantity of seed produced is much increased, and it is kept free from the admixture of weeds. When it is reaped it is left for some time in heaps or wads, and exposed to the dews: this does not injure the seed, and by softening the husk facilitates its separation by thrashing. The same effect may be produced by breaking off the heads from the stem with the flail, and pressing them close in casks or bags before they are perfectly dry; a slight fermentation takes place which renders the chaff brittle, and after some time the seed comes out very readily. The same thing is done with clover seed. The produce of an acre of canary seed is from three to five quarters.

CARAWAYS, the ripe fruit of *Carum Carui*, an umbelliferous, weedy, European plant, of annual or biennial duration, with finely-divided aromatic leaves, white small flowers, and a fusiform root, not unlike that of a small parsnip. The seeds, as they are vulgarly called, are the furrowed halves of the ripe fruit; they have a peculiar aromatic flavour, and are used as an agreeable carminative by confectioners; the roots themselves are eaten in the north of Europe.

Caraways are also used in medicine as a carminative, and are sold by the brewers' druggists to give flavour to the beer. The chief English cultivation of the plant is in Essex and Suffolk, upon old grass-land broken up for the purpose. As it is a biennial, it is generally sown with another plant of the same tribe called coriander; and sometimes a crop of teazels (Carduus fullonum) is raised on the same land: the three give a very valuable return during two or three years.

Arthur Young, in his 'Agricultural

Survey of Essex,' describes this mode of cultivation minutely. Some old pasture-land is ploughed up in spring; if the soil is a strong rich clay, so much the better. Ten pounds of caraway seed, ten pounds of coriander, and twelve pounds of teazel seed are sown together on the newly turned-up soil, and harrowed in. As the plants appear, they are carefully freed from all weeds, by repeatedly hoeing the land. The coriander is fit to be cut in July, and is thrashed out on a cloth in the field. The produce is frequently twenty-four cwt., worth on an average 16*s.* per cwt. The next year the caraway is reaped about the same time, and produces twenty cwt., worth 1*l.* per cwt. In the autumn of the same year the teazels are fit to be cut. The produce of these is very various; sometimes a load is obtained worth 12*l.*, at other times only a quarter of a load. The caraway and the teazels continue to produce for several years, provided they are kept clear of weeds; but after the third crop the return is not sufficient to be an inducement to continue them longer on the ground. The land, which would have been too rich for corn when first broken up, is now reduced to a moderate state of fertility. From this it is evident that it is only under peculiar circumstances that this profitable cultivation can be adopted.

CARROT. The large orange carrots which are the most common for winter provision, are chiefly raised in the fields; and when they can be conveyed to large towns for sale, they are a very profitable crop on light and deep soils. The principal use of carrots is as food for cattle. The orange carrot and its varieties are the most common in England, but the large white and yellow carrots are more esteemed on the continent; they are supposed to contain more saccharine matter and to produce a greater bulk of nutriment on the same ground. The white carrot also will grow on heavier soils than the orange, and may be sown in spring amongst barley, in the same manner as clover usually is; with this difference, that the roots are taken up before winter, and the land may be sown with winter corn the same year. This is commonly practised in Belgium. The barley amongst which the white carrots are sown is chiefly winter barley, which is reaped early. As soon as the barley is cut, the land is well harrowed to pull up the stubble, the weeds are carefully taken out, and liquid manure is poured abundantly over the surface. The carrots, which were scarcely visible, and of which the tops were cut off in reaping the barley, now shoot rapidly, and where they grow too thick are thinned out by hoeing. By the end of autumn a good crop of carrots is obtained; and if they are carefully forked up, the ground may be sown with rye without any other preparation.

When carrots are cultivated in a regular rotation as a principal crop, they are sown in March on land which has been ploughed to a considerable depth before winter, and has had the benefit of the winter's frost. It is not usual to manure the land, but it is best to sow carrots on land which has been abundantly manured for the preceding crop. If it be thought necessary to improve the land by manure, it must be done with well-rotten dung, which should be ploughed in very deep. Without this precaution the carrots will be apt to *fork*, as it is called; the root being divided will not swell regularly, and instead of being of a fleshy consistence will become fibrous and hard. The best mode of cultivation is to have the land in a moderately rich state and thoroughly pulverized; to sow the seed in drills, at the distance of a foot or more from row to row; to cover it slightly, and as the plants appear, to water them with diluted urine or the drainings of dunghills; to destroy all weeds carefully by the hand and the hoe, and to thin the plants in the rows to the distance of five or six inches or more, according to the richness and depth of the soil. Although the carrot, when it grows most vigorously, does not throw out any considerable fibres from the upper part of the root, and appears to draw its chief nourishment from its lower end, yet it is a great advantage to keep the ground stirred and light between the rows; for exceedingly minute horizontal fibres shoot out to a considerable distance from the sides of the root, and tend much to increase its size. The seed of the carrot has numerous hooked hairs which spring from the husk, and make the seeds adhere together; on this account carrot seed is usually mixed with earth or sand, and well rubbed in the hand before it is sown. Two pounds of seed are sufficient for an acre, if the seed is drilled; it requires double the quantity if sown broad-cast. In this last way very heavy crops are sometimes obtained, but the expense of weeding the carrots by hand is so great, that the drilled crops, besides being more certain, are more profitable. Seed which is two or three years old will vegetate, and it is more essential that it should be ripe and heavy than new. Too much care cannot be taken in selecting good seed. The finest and largest carrots should alone be chosen to plant out in spring to produce seed. They will throw out vigorous stems bearing numerous umbels, which, as the florets fade and the seeds ripen, contract into the form of a bird's nest. Those who are curious in the choice of the seed take only such seeds as grow on the outer border of the umbel. The tops of the carrots are frequently cut off before they arrive at the full size, as food for cattle and sheep, who are very fond of it; but this is not a judicious plan; as the loss in the growth of the roots from being deprived of the leaves is much greater than the value of the tops as food, especially if they are cut off repeatedly, which is sometimes done when fodder is scarce.

When the plants begin to wither, and the outer leaves to droop to the ground, the tops may be safely mown, and the roots left in the ground. They have then acquired their full growth, and will remain sound in the earth till there is danger from the winter's frost.

The best method of taking up the carrots to store them for winter use is by means of three-pronged forks, such as are used in digging asparagus beds. They should be rather blunt at the point and sides of the prongs, and be stuck into the ground vertically by the side of the rows; by pressing down the handle the carrots come up without injury. The plough is sometimes used after the coulter has been removed; but with all the care of the ploughman, the plough and the horses will cut and bruise many of the finest carrots. Carrots may be kept all winter in dry cellars, if they are protected against the frost. The more common way is to store them with straw in long trenches, like beet. [Beet.] The produce of carrots on good light land is nearly double that of potatoes, and they do not impoverish the land so much. From twenty to forty pounds of carrots, with a small quantity of oats, is a sufficient allowance for a hard-working horse for twenty-four hours. Where hay is scarce, it is a most economical substitute; and where the value of urine is known, carrots are much prized, as they greatly tend to its increase.

In Brittany they have an ingenious method of getting several acres of land trenched by the plough and the spade at the same time, for the growth of parsnips and carrots. The different farmers join to bring as many labourers together as will dig out a furrow as rapidly as the plough can draw it: they divide the whole length of the field equally among them. As soon as the plough has made a furrow, the men trench the bottom of it with their spades nine or ten inches deep, throwing the earth over the furrow slice last turned; on the return of the plough the next slice is turned into the deep trench and immediately covered by the spades as before. Thus an acre is readily trenched in one day to the depth of fifteen or eighteen inches, and all the weeds are buried: carrot or parsnip seed is sown on the surface and slightly harrowed in. The common mode of ploughing in stitches is the most convenient for this operation, as each man will only have to move from one side of the stitch to the other, immediately after the plough has passed. But a second plough following in the furrow made by the first will do the work equally well, and at less expense.

If carrots are cut in pieces and steamed, they become more nutritious, and the expressed juice made to ferment affords by distillation a very good and wholesome spirit. Sugar may also be extracted; but the carrot is inferior to the beet in this respect.

CART. The drag-cart without wheels, which is used in some mountainous districts, is one of the simplest contrivances for transporting heavy weights. It consists of two strong poles, from twelve to fifteen feet long, connected by cross pieces fixed at right angles to them, by mortising or pinning, so that the poles may be two or three feet apart. About eighteen inches of the poles project beyond the lowest cross-piece, the ends resting on the ground. The other ends of the poles form the shafts for the horse to draw by. The load is placed on the cross pieces, over which boards are sometimes nailed, for the purpose of carrying stones, or such things as might fall through between the cross bars: it then resembles the body of a cart taken off the wheels. The horse bears one end of the drag cart by a strap over his back, and drags it on by means of a common cart collar or a breast-strap. This vehicle is extremely useful in steep and rough descents, especially to draw stones from quarries, and can be made of rough poles at little or no expense. Pieces of hard wood fixed under the ends of the poles, and renewed as they wear out, will prevent the ends of the drag cart from wearing away and will allow it to slide along more easily.

Fig. 1.

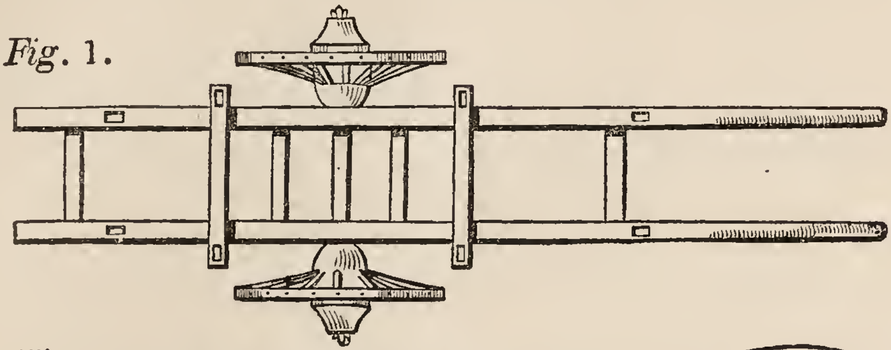


Fig. 2.

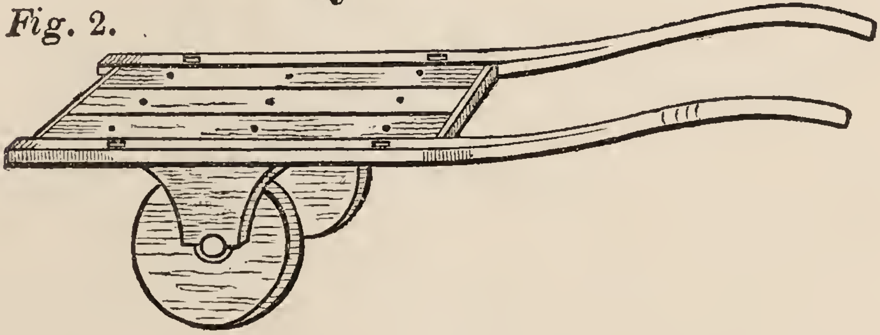
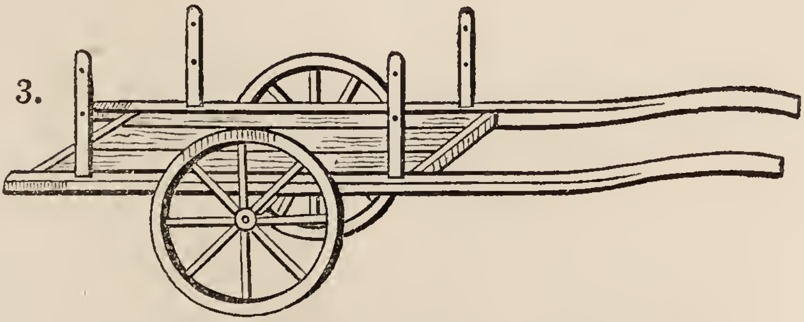


Fig. 3.



The Irish car (*Fig.* 2) may be considered as the next step towards a better construction. This car consists of a bed or platform and two shafts. The wheels, in the simplest form, are round disks of wood made by nailing planks two or three inches thick over each other, so that the fibres of the wood in one plank shall lie at right angles to those in the other. They are then sawn into the form of a circle, and an iron tire put on the circumference. Two of these disks are fixed on a square axle of wood at the distance of three or four feet from each other. The ends of the axle, which project three or four inches beyond the wheels, are then rounded in the form of cylinders of two or three inches diameter. To the under part of the bed of the cart two blocks of wood are fixed, which raise it so that the wheels may go under the cart, and in these blocks are two round holes to admit the ends of the axle. Two strong nails or iron pins driven obliquely into the blocks, after the wheels are put under, serve to prevent the axle from slipping out. A little grease on the ends of the axle diminishes the friction, and prevents the disagreeable grating of the wood when the wheels turn round. This is the simple old Irish car. The only difference in the construction of the most improved modern cars is the substitution of neat wheels and iron axles for those described above, and a railing or box fixed on the platform. The great simplicity of the Irish car, its easy construction, and the convenience of the platform to place the load on, are its greatest recommendations. It is well adapted to narrow mountainous roads; and the wheels being quite under the bed, there is less danger when two cars meet, or among trees and rocks; especially when one man has the charge of several cars, or the horses are permitted to find their way home by their own sagacity. There is a considerable inconvenience in turning, as the wheels do not turn separately, and one of them must be dragged along, while the other forms the centre round which the car turns. In the improved jaunting cars, the wheels are made to turn separately on the axles, by which this inconvenience is obviated. The wheels of the carriages on railroads are constructed on the principle of those of the Irish car. The axle turns with the wheels in a bush or box fixed to the carriage. This gives greater facility for keeping a constant supply of oil in the box by means of a fixed reservoir; and the carriage not being required to turn round, no inconvenience arises.

The common cart differs from the car in that the body rests on a fixed axle between the wheels, which turn upon the axle by means of boxes in the centre of the naves. The simplest cart is that used by carriers in France and Germany. (*Figs.* 1 *and* 3.) It consists of two strong poles of ash or beech, resembling those of the drag-cart described above, but stronger, and fashioned with more care, so as to have considerable strength at the place where they rest on the axle-tree. One end forms the shafts, and the whole is equally poised on the axle. The wheels are often nearly six feet in diameter, and narrow at the tire; they are slightly dished, but run nearly perpendicularly to the road. On these carts very great weights are transported, so as to require five or six horses to draw them. On paved roads they may have some advantages, but there is much loss of power when many horses draw at length, and the horse in the shafts is often much distressed by the weight suddenly thrown on his back, and by the striking of the shafts against his sides. It would be impossible for the shaft-horse to bear the weight in going down steep descents, or to keep his footing up steep hills (however well the cart may be poised), if it were not for an ingenious contrivance, by which the load is shifted at pleasure backwards or forwards on the axle. In ascending, the centre of gravity is moved nearer to the horse; and in descending, farther back, so as to be always nearly perpendicularly over the axle. Another contrivance is a mode of retarding the motion of the wheels in descending. This is done by forcing a pole against the outer rim of the wheel, one end being fixed to the shafts of the cart, and the other drawn, by means of a rope, tightly against the side of the wheel, which rubs hard against it. The object is thus obtained, but the wheels are soon worn away, and the pole requires to be carefully looked to, because it often wears through and breaks, when the whole load comes suddenly against the horse and throws him down. Another equally rude and extremely noisy mode is to cut a tough branch, a little longer than the distance between the wheels, and place it horizontally between the spokes, so that it projects about an inch or two on each side. The wheel, in turning round, bends the branch until the ends escape from one spoke and strike the next; thus a constant retardation of the wheel takes place at the expense of the spokes, which are soon worn out. A better contrivance is a piece of wood or iron in the form of a small segment of circle, of the same diameter as that of the wheel, which is made to press more or less on the rim of the wheels by means of a lever to which it is attached. It is regulated by a screw turned by a winch, which gives the exact pressure requisite to overcome the downward tendency of the load, and may be so nicely adjusted that it requires only a slight exertion in the horse to draw the cart down. By some of these contrivances many of the inconveniences arising from the use of carts are obviated. Where the roads are level and hard, waggons are much to be preferred to carts; but in hilly countries and bad roads, carts have many advantages.

For agricultural purposes, various kinds of carts have been invented. The capacious tumbril for carting earth and dung, with broad wheels to prevent their sinking in soft ground, is too generally known to require description. The best constructed carts have iron axles with the ends or arms turned smooth, and very slightly conical. The boxes in the naves of the wheels, which receive the arms, are made of cast-iron, and ground smooth so as to require only a small quantity of grease or oil to make the wheels run easily, without allowing any play or side motion. It is usual to give the axle a bend at the place where it enters the wheel, by which means the planes of the wheels are made to diverge from each other and give more room for the body of the cart. But this is decidedly wrong. It is clearly proved that the draught is least when the arms are quite horizontal, and if the wheels are slightly dished, that is, if the spokes are driven into the nave obliquely so as to throw the rim a little beyond the perpendicular, the lower part of the spokes in each wheel will slightly diverge, and give greater steadiness to the whole. When the axle is bent, the rim of a broad-wheeled cart must be slightly conical, in order that it may rest flat on the ground; and it is easily proved that in this case the load is dragged on the road at every revolution, along a space equal to the difference between the greater and lesser circumference of the rim of the wheel, giving unnecessary work to the horses, and greatly injuring the roads. The light Scotch cart, drawn by one horse, is justly considered as the most advantageous for transporting earth, lime, or dung, especially in hilly countries. It is low and short, so that the horse draws very near the centre of gravity; and there is little power lost by obliquity. The loads may be so adjusted as to bear more or less on the horse, according to the declivity; and experience has proved that more weight can be transported by a given number of horses, when each is attached to a single Scotch cart, than when three or four draw together, except it be on very level and hard roads, or when the horses move at a quick pace. The objection made to single-horse carts, that each requires a man to drive it, is obviated in Scotland, where the horses are trained to follow each other, and one man can attend to several carts and horses. In England this is not allowed on the roads for fear of accidents.

The Scotch cart is made to carry hay and straw by means of a light frame, which is laid on it, and projects over the body and the wheels in every direction. At harvest it is found to collect the sheaves of corn and carry them to the stack or barn more rapidly than could be done by a waggon. A good horse will walk faster, when he has a load on his back, than he could do if he were merely drawing; and although this exertion, if continued long, would exhaust him, he soon recovers his breath, if he has only been urged for a small distance, and then returns with a light empty cart.

To avoid the weight resting on the back of the horse, carts have been invented with three wheels, the small additional wheel being made to turn in front. It is only in the case of moving earth down a declivity, and returning with the empty cart, that it has any advantage over the two-wheeled cart; it is therefore seldom used for general purposes. The additional wheel adds to the weight which the horse has to draw, and is an incumbrance in a ploughed field.

The addition of springs to carts and waggons is a very great improvement, and should be adopted in every case where they are much used on the roads. The additional weight of the springs and their cost are greatly overbalanced by their advantage: they lessen the draught, and, by preventing jolting and shaking, add to the durability of the vehicles. Where a light active kind of horse is used which can trot with a moderate load, it will be found that there is a great advantage in occasionally increasing the pace at which empty carts and waggons are made to move. In Holland and Flanders the waggons are always driven at a smart trot when going empty to the field in harvest or hay-making, and much valuable time is saved by this means.

CATTLE. In its most extensive sense the word cattle denotes all the larger domestic quadrupeds, which are used for draught or food. In the usual acceptation of the word it is confined to the ox, or what is called black cattle or horned cattle. But as many varieties are not black, and several have no horns, the name of *neat cattle* is more appropriate. The rearing and feeding of cattle is a very important branch of agricultural industry. Much of the success of a farmer depends on the judicious management of live stock, without which his land cannot be maintained in a proper state of fertility. The breeding and fattening of cattle are generally distinct occupations. It is of the greatest importance to the breeder, as well as to the grazier, to ascertain the qualities of each different breed of cattle; to determine which is best suited to his purpose, and which will bring him the greatest profit.

The domestic bull and cow are probably of Asiatic origin. In those countries where they are now found in a wild state, they are evidently descended from domestic animals which have been let loose, or have strayed from the habitations of man. The *Urus*, which ranged wild in the Hercynian Forest, and was a dangerous enemy to those who encountered him, appears to have differed little from the common bull. If he was an indigenous wild animal, he was perhaps the original stock from which our different European varieties sprung, modified by climate and difference of pasture. This, however, is denied by naturalists, who consider him a distinct species (the bison). The small Hindoo ox with a hump on the chine, and the African Cape ox, which is used for riding as well as draught, and has no hump, are both more nearly allied to the buffalo. They are very tame, and more intelligent than the generality of our oxen, owing probably to their being more nearly associated with their masters. Of the cattle on the continent of Europe, one of the principal breeds is the Polish or Ukraine. The oxen of this breed are large and strong, and fatten readily in good pastures. Their flesh is succulent and well tasted; but the cows do not readily allow themselves to be milked, and consequently are not fit for the dairy. The colour is generally a light grey, seldom either black or white. They are docile when worked; but are not considered so hardy and strong as the Hungarian oxen, which resemble them in colour, but are more compact, and have shorter limbs. The horns are large and spreading, which gives them a formidable appearance, and compared with the more improved and carefully bred cattle, they are heavy and coarse. When they are stalled in winter on hay and roots, they bring a considerable profit by fattening very soon. They are driven in herds from the extensive plains in which they are bred, and sold to graziers in the adjoining districts of Germany.

In the plains of Jutland, Holstein, and Schleswig, there is a very fine breed, with small short crooked horns, which appears to be nearly allied to the Friesland and to our own Holderness breed. They are of various colours; but mouse or fawn colour, interspersed with white, are the most common. Red cows of this breed are seldom seen. They are good milkers in moderate pastures, and the oxen fatten readily when grazed or stall-fed at a proper age. They are fine in the horn and bone, and wide in the loins; but they are not considered so hardy and strong for labour as the preceding breed. If prejudice did not make the breeders select the calves with large bone and coarse features to rear as bulls, in preference to those which resemble the cows, this breed would in every respect equal our best short-horns. The cows are frequently fattened while still in milk, and are fit for the butcher by the time they are dry; the same system is followed by the great milkmen in the neighbourhood of London, with their large Holderness cows. This breed is much esteemed in all the northern parts of Europe. The Friesland, Oldenburg, Danzig, and Tilsit cattle are mostly varieties of this short-horned breed.

Towards the Alps the cattle have a different character; they are strong and active, and can range wider in search of pasture. The largest and finest breed is the Swiss, especially the Freyburg race, which is found in the rich pastures between the mountains in the neighbourhood of Greyerz (Gruyères), a place well known for its excellent cheese, which is consumed all over Europe. The cows, which are here the principal object of attention, are large and wide in the flanks, and strong in the horn—(we should rank them in England among the middle-horns)—short and strong in the bone, with a prominence at the root of the tail, which, according to our notions, would be considered a great blemish. They give abundance of rich milk when ranging in their native Alps, or when stalled and fed with clover or lucern in the stables. The oxen work well, but are rather heavy and slow. When fed off they fatten well; and although fat meat is not much prized there, some carcases may be seen slaughtered in Bern and Freyburg which are equal to those in the best English markets.

There is a smaller but very active mountain breed of cattle in the Jura, which does well on scanty food. The cows are small and slight, generally of a light red colour. The oxen are very active and strong for their size. They draw invariably by the horns. They are not considered so profitable for stall feeding as the larger, but they are excellent for the small cottagers on the borders of the mountains, and find their sustenance among the woods and rocks, where they climb like goats.

The Norman breed gives the character to all the cattle usually met with in the northern part of France, except near the Rhine. They are mostly of a light red colour, sometimes spotted with white. Their horns are short, and stand well out from the forehead, turning up with a black tip; the legs fine and slender; the hips high, and the thighs thin. The cows are good milkers, and the milk is rich. They are in general extremely lean, which is owing in a great measure to the scanty food they gather by the sides of roads, and along the grass balks which divide the fields. In Normandy itself they have good pastures, and the cattle are larger and look better. The Alderney and Jersey breeds, which from the extreme richness of their milk are much prized in gentlemen's dairies in England, are smaller varieties of the Norman, with shorter horns, more turned in, and a still more deer-like form.

The Italian breeds are not very remarkable, except from the immense length of the horns of some of them. No great pains are taken to improve them, except in some parts of the north of Italy, where the Parmesan cheese is manufactured: there they resemble the Swiss breed, and are probably only varieties of the same stock.

The different British and Irish breeds have been generally distinguished from each other by the length of the horn. The long-horned breed is supposed by many to be indigenous. Others consider the middle-horned as the old breed. The former was chiefly found in a district of Yorkshire called Craven, and was greatly improved by the skill of Robert Bakewell, of Dishley Farm, in Leicestershire, and hence they are called the Dishley breed. The distinguishing character of this breed are long horns growing downwards from the side of the head and ending in straight points parallel to the jaw. In order to give an adequate idea of the qualities of this improved breed, we must consider what breeders and graziers call the fine *points* of an ox. These are certain forms and appearances, which are either anatomically connected with a perfect conformation of the body, and especially of the organs of respiration and of digestion, or which are constantly associated with the peculiar qualities of certain breeds, so as to be proofs of their purity. Of the first kind are a wide chest, well formed barrel, strong and straight spine, hip-bones well separated, and length of quarter, all which can be proved to be essential to the perfect functions of the body. Small and short bones in the legs give firmness without unnecessary weight. A thick skin well covered with hair insures proper warmth, and its soft loose feel indicates a good coat of cellular substance underneath, which will readily be filled with deposited fat. All these are indispensable points in an ox which is to be profitably fatted, and whatever be the breed, they will always indicate superiority. Other points, such as colour, form of the horns, shape of the jaw, and setting on of the tail, with other particulars, are only essential in so far as experience has observed them in the best breeds, and as they are indications of pure blood. The eye is of great importance; it should be lively and mild, indicating a healthy circulation, with a gentle and almost indolent temper. An animal that is not easily disturbed will fatten rapidly, while one that is restless and impatient will never acquire flesh. Amongst the antients, a deep dewlap was considered as a great beauty in an ox. In some of our best breeds there is scarcely any. The rump of the Freyburg cows, as we observed before, rises high towards the tail; while a straight back from the neck to the tail is indispensable in a well-bred British ox.

Having established a breed which has many superior qualities, attention is paid to maintain its purity; and to those who cannot ascertain the parentage, certain marks are satisfactory proof of purity of blood. The new Leicester long-horn oxen were noted for the smallness of the bone and their aptitude to fatten. Their flesh was fine-grained, the fat being well intermixed in the muscles. At the time when Bakewell died, about 1795, no other breed could be brought into competition with his improved long-horns. But whether his successors have not paid the same attention to keep up the qualities of the breed, or it has degenerated in comparison, they have since lost much of their reputation, and the short-horned breed has now the superiority. Good long-horned cattle are, however, occasionally seen in the midland counties. One defect of the breed was, that the cows gave but little milk, and this may be the reason for now preferring the short-horns. The Teeswater or Holderness breed of cattle was produced by the importation of cows from Holstein or Holland, and careful breeding and crossing. They now much excel the original stock. The principal improver of the Teeswater breed was Mr. Charles Collins. By his care a breed has been produced which is unrivalled for the dairy, and for fattening readily. Almost every good breed now in existence traces its pedigree to his bulls, especially one of the first he used, called *Hubback*. The famous ox exhibited thirty years ago, under the name of the Durham ox, was of this breed. By careful crossing with a Galloway cow, an improved breed was produced, which was in such repute that at a sale of Mr. Collins's stock of short-horns, October 11, 1810, a famous bull, called Comet, sold for 1000 guineas, and 48 lots of bulls, cows, and calves realized 7115*l.* 17*s.* (*Library of Useful Knowledge*, "Cattle," p. 233.) The short-horn cattle are mostly light coloured, some quite white, but most are speckled with red and white, without any large distinct spots. The horns are very short. In the cow, the points turn inwards towards each other. Some of the finest bulls have merely a tip of a horn standing out from each side of the forehead. In the carcase they have every point which we have before enumerated as essential to perfection.

Besides the two breeds above mentioned, there are several in great repute in particular districts, which almost dispute the superiority with the short-horns. Of these the Devonshire breed is the handsomest. The colour of this breed is invariably red, with a very fine head, small bone, and glossy hide. The oxen, although not so heavy as some, are the best for the plough on light lands; they walk nearly as fast as horses, and will work almost as well in pairs. The cows are good milkers, any deficiency in quantity being made up by the richness of the cream. The oxen fatten readily, and their flesh is of the best quality.

The Sussex breed is only distinguished from the Devon by being rather stronger, and not so fine in the head and horn.

The Herefordshire breed is larger and heavier than either of the preceding, the horns longer and more turned outwards; the colour is red, but the belly and the face are generally white, and there is often a white stripe along the back. This breed has many excellent qualities, and fattens well; but the cows are of little use for the dairy, from the small quantity of milk they yield. The Herefordshire oxen are best suited to the rich pastures of their native county, where they grow to a great size and increase fast. These are the principal English breeds. Of the Welsh breeds, the Glamorganshire cows are in good repute for the dairy; they are of a dark brown colour with a white stripe along the back, long white horns pointing rather forwards and upwards; the tail is set on rather high above the back, which is thought a defect, but in this they are much exceeded by the Freyburg cows mentioned above, which have great merit notwithstanding. The other Welsh breeds are distinguished chiefly by their hardy constitutions, which they owe to their having been bred in mountainous districts. Great droves of them come to all the English fairs; their low price and small expense of keep render them an object worthy the attention of cottagers and small farmers; they are best calculated to run on rough heaths and commons.

The principal indigenous Scotch breeds are the West Highland, the Galloway, the Angus, and the Shetland. There is a doubt whether the Ayrshire should be classed amongst the pure Scotch cattle. Their great resemblance to the short-horn in all but the size leads one to suppose that they are a cross of a smaller breed by a short-horn bull, but they have very good qualities, and are excellent for the dairy or for stalling.

A great many cattle are bred in the various islands which lie on the western coast of Scotland. They are mostly of a small black breed, called Kyloes. They are very hardy, and, when brought into good pasture, fatten rapidly and produce the finest and best-flavoured beef. They are found in the greatest perfection in the Isle of Skye, and are sent annually in large droves from their native islands, and dispersed through Scotland and England. They are particularly in request in Norfolk, Suffolk, and Essex, where they are wintered on turnips, and sent to Smithfield in the spring and summer following. If they do not produce so great a weight of beef as many other breeds, they always bring the highest price in the market, and require but a very short time to get fat. The Galloway is a peculiar breed, which has many good qualities: it has no horns; the body is compact, and the legs short; and few breeds can vie with the Galloway oxen and heifers in aptitude to fatten. There is a peculiar roundness in all the parts of the body, which makes the animal look well in flesh, even when he is lean. The skin is loose, and the hair soft and silky to the touch. They are mostly black, but some are of a dun colour, which shows a connection between this breed and the polled Suffolk. It is only the colour which distinguishes them. Many of the Galloway heifers are spayed, and get very fat at an early age. The Galloway cows are not very good milkers, in which respect they differ from the Suffolk, but their milk is very rich.

The *Angus doddie* is also a polled breed, and has been long in repute. It is probably a variety of the Galloway, to which it bears a strong resemblance, but it has been found in Angus from time immemorial.

The Shetland cattle are very diminutive and coarsely shaped, but their flesh is reckoned well flavoured. They are seldom driven into England or the South of Scotland, because when fat they attain but a very small weight. The breed is, however, worth the notice of experimental agriculturists.

The Aberdeenshire and Fifeshire breeds are horned, and have been produced by various crosses with short-horns and other English breeds. All the Scotch breeds have been greatly improved by the premiums given by the Highland Society for the encouragement of breeding.

Of Irish cattle, the small Kerry cow seems to be purely native. It is a useful breed for cottagers, requiring but moderate keep and care, and giving a considerable quantity of milk in proportion to the size of the animal and the food it requires.

The best Irish cattle are produced by crosses with the improved Leicester longhorns, and in the rich pastures of the south many fine animals were reared and slaughtered for the use of the navy during the war.

These are the principal breeds of cattle in the United Kingdom. By selecting those which are best suited to each situation and pasture, the industrious farmer may add considerably to his profits, and at the same time enrich his land with the manure. In purchasing cattle it is very necessary that the age should be readily ascertained: the surest mode of doing this is by examining the teeth. A calf has usually two front teeth when he is dropped, or they will appear a day or two after his birth; in a fortnight he will have four, in three weeks six, and at the end of a month eight. After this, these milk-teeth, as they are called, gradually wear and fall out, and are replaced by the second and permanent teeth. At two years old the two middle teeth are replaced; the next year there will be four new teeth in all: at four years there are six permanent teeth, and at five the whole eight are replaced. The milk-teeth do not always fall out, but are sometimes only pushed back by the second set; and in this case they should be removed with an instrument, as they impede mastication and irritate the mouth. After six years old the edges of the teeth begin to wear flat, and as they wear off the root of the tooth is pushed up in the socket, and the width of the teeth is diminished, leaving interstices between them: this begins in the middle teeth, and extends gradually to the corners. At ten years old the four middle teeth are considerably diminished, and the mark worn out of them. After fifteen years of age few cows can keep themselves in condition by pasturing; but they may continue to give milk, or be fattened by stalling and giving them ground food. Horned cattle have rings at the root of the horns, by which the age may also be known. The first ring appears at three years of age, and a new one is formed between it and the skull every year after. But this mode of ascertaining the age is not so sure as by the teeth, deception being much easier by filing off the rings.

In order to learn by experience what breed of cattle is most profitable, it is very advantageous to weigh them occasionally and note their increase. For this purpose several simple and ingenious weighing machines have been invented. For want of better, a strong kind of steel-yard may be made of a young fir-tree, about twenty feet long, suspended from a strong beam by a hook fixed about a foot from the thickest end, to which is attached another hook, from which descend strong flat hempen bands, forming two loops joined together by iron rings. These are put under the belly and chest of an ox; and a weight hung at the smaller end of the pole, just sufficient to lift him off his legs, readily gives his live weight. Experience has shown the proportion between the saleable quarters and the offal, in different states of fatness; and tables have been constructed by which the net weight is found by mere inspection. Multiplying the live weight by 0·605, gives a near approximation to the neat dead weight in an ox moderately fat and of a good breed. When an ox is fat, his weight may be very nearly guessed by measuring his girth immediately behind the fore legs, and the length from the tip of the shoulder to the perpendicular line which touches the hinder parts, or to a wall against which the animal is backed. The square of the girth in inches and decimals is multiplied by the length, and the product multiplied by the decimal ·238. This gives the weight of the four quarters in stones of 14 lbs. This rule is founded on the supposition, that there is a certain proportion between the net weight of the quarters and that of a cylinder, the circumference of which is the girth, and the axis the length taken as above. The proportion has been ascertained by observation and repeated comparison.* The measurement will at all events indicate the proportional increase during the period of fattening.

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* If g be the girth and l the length taken as above, a the area of a circle whose circumference is unity, then $l g^2 a =$ cylinder; and if the proportion of this cylinder has been found by repeated

Cattle are not subject to many diseases, if they have plenty of food and good water, and are kept clean. Air is essential to them, and although cows will give more milk, and oxen will fatten better when kept in warm stalls in winter, they are both less subject to diseases when they are kept in open yards, with merely a shelter from the snow and rain. Epizootic diseases, which sometimes ravage whole districts, are less known in England than in most countries. For the peculiar diseases of cattle see Ox.

The most economical mode of feeding cattle is evidently by allowing them to seek their food on commons and uncultivated pastures; but it is only in particular situations that it is the most advantageous. Cattle fed on commons add little to the stock of manure, except when they are kept in the yards or stalls in winter: even then their dung is of little value, if they are merely kept alive on straw or coarse hay, as is generally the case where the stock is kept on commons or mountains in summer. When they feed in inclosed and rich pastures, their dung falling in heaps on the grass does more harm than good. The urine fertilizes the soil in wet weather when it is diluted; but in dry weather it only burns up the grass. If we calculate what would be the amount of dung collected if the cattle were kept in yards or stables, and fed with food cut for them and brought there, and also the loss of grass by treading on the pastures, we shall have no doubt whether the additional labour of cutting the grass and bringing it home daily is not amply repaid by the saving. But if we also take into the account the variety of artificial grasses, pulse, and roots which may be grown with advantage on land unfit for permanent grass, and the quantity of arable land which may thus be kept in the highest state of cultivation, we shall be convinced that the practice of those countries where the cattle are constantly kept at home is well worthy of imitation. It may be of use to the health of the animals to be allowed to take a few hours' air and exercise in a pasture near the stable; but there is no advantage in their having any grass crop there: on the contrary, the barer of grass the surface is, the better. They will relish their food better when they are taken in after a few hours' fasting. A bite of fresh short grass might, on the contrary, give them a dislike to their staler food. When cut grass is given to cattle in the stalls, it is best to let it lie in a heap for at least twelve hours before it is given to them. It heats slightly, and the peculiar odour of some of the plants, which oxen and cows are not fond of, being mixed with that of the more fragrant, the whole is eaten without waste. Experience has shown that many plants which cattle refuse in the field, where they have a choice, have nutritious qualities when eaten mixed with others in the form of hay. There are few deleterious plants in good grass land or water-meadows, and these are readily distinguished and weeded out.

The quantity and quality of the dung of cattle which are stalled and well fed is so remarkable, that its value makes a considerable deduction from that of the food given; especially of green food, such as clover, lucern, tares, and every kind of leguminous plant: we shall not be far wrong, if we set it at one-fourth. This supposes a sufficient quantity of straw for litter, and an economical collection of the liquid parts in proper reservoirs or tanks. In order to make the feeding of cattle advantageous, the buildings must be conveniently placed with respect to the fields from which the food is to be brought. Moveable sheds with temporary yards, which can be erected in different parts of a large farm, according as different fields are in grass or roots, are a great saving of carriage, both in the bringing the food to the cattle and carrying the dung on the land. A clay bottom should be selected, in a dry and rather high spot, if possible.

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trials to be to the weight of the carcase in stones of 14 lbs. as $b : 1$, then $l g^2 \times \frac{a}{b}$ is the net weight. In this case $\frac{a}{b}$ has been found $= 0{\cdot}238$. $\therefore l g^2 \times 0{\cdot}238$ is the weight.

But if permanent buildings for cattle, constructed of rough materials and thatched with straw, were erected in the centre of about forty acres of arable land, in different parts of a large farm, it would probably be a great saving in the end.

Good water is most essential to the health of cattle, and that which has been some time exposed to the air seems the best for them. When they are fatted in stalls on dry food, they should always have a trough of water within reach. A piece of rock-salt to lick, or some salt given with their food, is highly conducive to their health, and will restore their appetite when it begins to flag. Rubbing the hide with a wisp of straw or a strong brush, as is done to horses, may appear a useless labour, but it is well known that there is no better substitute for that exercise which is essential to health. Where labour is not regarded, as is always the case when the owner of the cattle attends upon them himself, the curry-comb and the brush are in regular use, and the advantage derived from the use of them is undeniable.

In those countries where the farmer is allowed to distil a spirit from his grain, it is a great advantage to an agricultural establishment to have a distillery attached to it, especially in a remote situation: and not only is the fattening of cattle on the refuse of the distillation a source of profit, but the manure extends fertility around. The produce in spirits and in cattle is easily transported to a great distance, and almost the whole of what is produced by the land returns to it in the shape of manure. The same may be said of the manufacture of sugar from beet-root, which has been lately so much extended in the north of France.

It can never be too much impressed upon the minds of agriculturists, that without dung there is no corn; without cattle there is no dung. Every means should therefore be used to encourage the breeding and feeding of cattle, and none can be more effectual than to show that the profits of a farm are always proportioned to the quantity of cattle kept, and the abundance of the food provided for them.

CHALK is composed of nearly 44 parts of carbonic acid and 56 of lime. It is extensively used in agriculture, to improve various soils. The best land for the growth of wheat contains a certain portion of argillaceous, siliceous, and calcareous earth; and when this last is deficient, the addition of chalk improves the soil more than any quantity of animal or vegetable manure could do alone. Lime produces a greater effect by its caustic nature; but as it is always put on the land in much smaller quantities than chalk, it does not so permanently improve it. Good chalk should be firm and compact, should break readily, and crumble into a fine powder; it should readily absorb moisture, and when the lumps are exposed to frost after having been wet, they should break into minute square fragments. Chalk is called a manure, and it is in as far as everything which increases the crop may be so called; but it is a great mistake to suppose that it may be substituted for animal and vegetable manures. Chalk may so far supersede dung that where it is used a portion of the latter may be dispensed with; but its chief use is to improve the texture of the soil, and render it better adapted to receive and retain moisture, so that a smaller portion of dung will have a greater effect than a larger portion would without it. No good agriculturist will trust to chalk alone on poor exhausted land, although he may do so where the soil is full of nutritive matter. In this last case however, lime would be much more effectual; but chalk will make dung work well, and hence it is most frequently mixed into a compost with it, or alternate heaps of dung and chalk are put upon the land and mixed in the spreading. When chalk is used, it is of great importance to ascertain whether the natural soil contains more or less of calcareous matter. The less of this matter is found in it on analysis, the greater improvement is produced by chalk; hence the common saying, that the farther you are from a chalk-pit the more valuable is the chalk.

The soils most improved by it are the strong wet clays, which contain a portion of iron. Chalk acts as an absorbent corrects astringency, and prevents, by its interposition between the particles of clay, that running into a solid mass, which is so detrimental to the roots of plants by entirely excluding atmospheric air. On loose sands its effect is different; there it acts chiefly as a cement, and the more argillaceous it is, the better it binds the siliceous particles. For light soils marl is preferable, especially when a considerable coat can be put on the land. The clay which is so abundantly used in some parts of Norfolk, and is found in many places at a small depth below the surface, owes much of its virtue to the calcareous matter which it contains, and where this is deficient, it will not much improve the soil until chalk or lime be added. Chalk is used wherever it can be procured within a moderate distance, and the soil is stiff; as in the counties of Essex, Suffolk, Berkshire, Middlesex, Buckinghamshire, and many others. In those districts where chalk is much used, it is generally put on the land in autumn, and not ploughed in till it has been exposed to the frost; or it is laid in long heaps on a headland, or by the side of a road or lane, and there turned over and mixed with the earth on which the heaps are laid. If it be exposed to the sun in summer, it must be carefully covered with earth, or it will harden so much by drying that it will be very difficult to pulverise it afterwards, and the frost will not have the same effect upon it. Ten tumbril loads of chalk, and as many of good farm-yard dung, are a very good dressing either on a fallow for wheat or previous to sowing turnips. When chalk is laid on permanent meadows, it promotes the growth of white clover; but except the meadows are wet and produce rushes, it is of no very great benefit to the grass, although it shows its effect when the grass is broken up. When land is cultivated according to the convertible system, the best time to put chalk on the land is when it is about to be ploughed up. If the grass is fed off the last year, the chalk may be put on during the preceding winter, and simply spread over the grass; it will thus be pulverised by the frost, will sweeten the pasture, and its full effect will be perceived in the first grain-crop after the land is ploughed up. When chalk has been some time in the land, it is gradually carried below the soil by the filtration of the surface-water. After a few years therefore it requires to be renewed, which shows the advantage of putting on a moderate quantity and repeating it in six or seven years, in preference to putting on a large quantity at once, unless where lands are reclaimed from a state of waste, and require to be improved by a large admixture of calcareous matter before they can be made productive by enriching manures. This is the case with those yellow loams which contain much iron, and which are generally found under the *iron pan*, so well-known to all those who improve poor light heath-land. [Barren Land.]

An important use of chalk is to form ponds in porous soils for the use of cattle. A stratum of chalk a few inches thick, protected by a coat of gravel and sand to prevent its being trod through, will effectually retain the water; and if a considerable proportion of salt is beat up with it and intimately mixed, it will effectually prevent worms from making lodgments in it, and keep in water for a very long time. It is of advantage to throw chalk into all ponds used by cattle; it corrects any acidity which may arise from stagnation, and the water in which chalk is diffused is more wholesome than that which contains clay alone. In fattening calves chalk is of the greatest use; it may be laid in the calf-pens for them to lick, which they will readily do, or it may be scraped and mixed with a small quantity of salt, and laid in a small manger within the reach of each calf. It effectually prevents scouring, and keeps their digestion in a proper state.

In many parts of England the whole sub-soil to a great depth is a solid mass of chalk, and the earth which covers it contains very little else than carbonate of lime, with a small portion of vegetable matter in a decomposed state. In this soil a short sweet herbage grows, which is extremely grateful to sheep; accordingly the chalky hills, called downs, in Sussex, Wiltshire, &c., are chiefly devoted to sheep-pasture. Along the sides of these hills where the waters continually accumulate the finer particles of the soil which are washed down from above, some very productive arable lands are formed, and very good crops of barley are raised. There is a plant which seems to delight in chalky soils, and to flourish better there than in deeper and richer earth. This is the sainfoin (*Hedysarum Onobrichis*), and its introduction among the cultivated grasses has greatly raised the value of chalky land, previously considered too poor to repay cultivation. It not only produces an excellent fodder, superior to meadow-hay and scarcely inferior to clover, but by its roots it so divides and enriches the soil, that after having covered it with luxuriant crops of hay for several years, it leaves it in a fit state to produce excellent crops of grain, with very moderate manuring.

Chalky soils are not subject to the same perennial weeds which infest richer lands; couch-grass is seldom found in chalk, but the annuals, such as May-weed, charlock, poppy, crow-foot, and several others, abound in it. When a chalky soil produces thistles, it is an indication of its containing a portion of argillaceous earth, which improves its fertility.

CHEESE. The milk of animals consists of three distinct substances, which are separated from one another by a slight change, which begins as soon as it is exposed to the air. The oily part rises to the surface by its less specific gravity; and when it is collected into a solid mass by agitation it forms butter; the curd, coagulated by the action of any acid, and pressed, becomes cheese · and the fluid which remains is the serum or whey.

In the making of cheese there are certain general principles which are essential, but slight variations in the process produce cheeses of very different qualities; and although the most important circumstance is the nature of the pasture on which the cows are fed, yet much depends on the mode in which the different stages of the fabrication are managed; and hence the great superiority of the cheeses of particular districts or dairies over those of others, without any apparent difference in the pasture. By skill and great attention excellent cheeses are made in places where the pastures are not considered so well adapted to produce milk of a proper quality; and in those countries where the cows are chiefly kept tied up in stalls, and are fed with a variety of natural and artificial grasses, roots and vegetables, superior cheese is often made.

The first process in making cheese is to separate the curd from the whey, which may be done by allowing the milk to become sour; but the cheese is inferior in quality, and it is difficult to stop the acid fermentation and prevent its running into the putrefactive. Various substances added to milk will soon separate the curd from the whey. All acids curdle milk. Muriatic acid is used with success for this purpose in Holland. Some vegetables contain acids which readily coagulate milk, such as the juice of the fig-tree, and the flowers of the *Galium verum*, or yellow lady's bed straw, hence called *cheese-rennet.* Where better rennet cannot be procured, they may be substituted for the most natural curdler of milk, which is the gastric juice of the stomach of a sucking calf. This juice rapidly coagulates the milk as the calf sucks; and the only difficulty is in collecting and keeping it from putrefaction, which begins from the instant the stomach is taken from the calf. The preparation of the *rennet,* as it is called, is a most important part of the process of cheese-making. The following may be considered as the simplest, and perhaps the best. As soon as a sucking calf is killed the stomach should be taken out, and if the calf has sucked lately, it is all the better. The outer skin should be well scraped, and all fat and useless membranes carefully removed. It is only the inner coat which must be preserved. The coagulated milk should be taken out and examined; and any substance besides curd found in it should be carefully removed. The serum left in it should be pressed out with a cloth. It should then be replaced in the stomach with a large quantity of the best salt. Some add a little alum and sal prunella; others put various herbs and spices, with the view of giving the cheese a peculiar flavour, but the plain simple salting is sufficient. The skins, or vells, as they are called, are then put into a pan, and covered with a saturated solution of salt, in which they are soaked for some hours; but there must be no more liquor than will well moisten the vells. They are afterwards hung up to dry, a piece of flat wood being put crosswise into each to stretch them out. They should be perfectly dried, and look like parchment. In this state they may be kept in a dry place for any length of time, and are always ready for use. In some places, at the time of making cheese, a piece of a vell is cut off and soaked for some hours in water or whey, and the whole is added to the warm milk. In other places, pieces of vell are put into a linen bag and soaked in warm water, until the water has acquired sufficient strength, which is proved by trying a portion of it in warm milk. The method employed in Switzerland is as follows:—A dry vell is taken and examined; it is scraped with a knife, and where any veins or pieces of tough membrane appear they are removed. The whole surface is examined and washed carefully, if any dust or dirt has adhered to it; but otherwise it is only wiped with a cloth. A handful of salt is then put into it, and the edges of the vell are folded over and secured with a wooden skewer stuck through it. In this state it forms a ball of about three inches' diameter, and is laid to soak twenty-four hours in a dish containing about a quart of clear whey, which has been boiled, and all the curd taken out. The next day the vell is well squeezed, and put into fresh whey; the first infusion being put into a proper vessel, the second is afterwards mixed with it and bottled for use. Half a pint of this liquor of a proper strength is sufficient to curdle forty gallons of milk. Experience alone enables the dairyman to judge of the strength of his rennet; for this purpose he takes in a flat ladle some milk which has been heated to about 95° of Fahrenheit, and adds a small measure of rennet. By the rapidity with which it curdles, and the form of the flakes produced, he knows its exact strength, and puts more or less into the cauldron in which the milk is heated for curdling. A simple instrument might easily be invented, by which the exact degree of strength might be ascertained, and a rule given to guide the less experienced; but as long as a man feels a superiority acquired by experience alone, he is not likely to encourage any contrivance which would place others on a level with himself. From this cause even the thermometer has not been introduced generally into any great dairy, nor have any certain rules been given to ascertain the exact heat required in the milk, when the rennet is added, to form the best curd.

There are different kinds of cheese, according to the mode of preparing it; soft and rich cheeses are not intended to be kept long; hard and dry cheeses are adapted to be kept and stored for provisions. Of the first kind are all cream cheeses, and those soft cheeses, called Bath cheeses and Yorkshire cheeses, which are sold as soon as made, and if kept too long become soft and putrid. Stilton and Gruyere cheeses are intermediate; Parmesan, Dutch, Cheshire, Gloucestershire, and similar cheeses, are intended for longer keeping. The poorer the cheese is the longer it will keep; and all cheese that is well cleared from whey and sufficiently salted will keep for years. The small Dutch cheeses called Edam cheeses are admirably adapted for keeping, and form an important article in the victualling of ships.

The Gruyere and Parmesan cheeses only differ in the nature of the milk, and in the degree of heat given to the curd in different parts of the process. Gruyere cheese is entirely made from new milk, and Parmesan from skimmed milk. In the first nothing is added to give flavour; in the latter saffron gives both colour and flavour: the process in both is exactly similar. A large cauldron in the shape of a bell, capable of holding from 60 to 120 gallons of milk, hangs from an iron crane over a hearth where a wood fire is made. The milk, having been strained, is put into this cauldron, and heated to nearly blood-heat (95° to 100°). It is then turned off the fire, and some rennet, prepared as stated above, is intimately mixed with the warm milk by stirring it with the hand, in which is held a flat wooden skimming-dish, which is turned round in the milk while the hand and arm stir it. A cloth is then laid over the cauldron, and in half an hour, more or less, the coagulum is formed. This is ascertained by pressing the skimming-dish on the surface, when the whey will appear on the part pressed. If it is longer than an hour in coagulating, the milk has been too cool, or the rennet not strong enough. The weather has a great influence on the process of the dairy, and there is much yet to be learned by accurate observations with meteorological instruments, especially electrometers. When the curd is properly formed, it is cut horizontally in thin slices by the same skimming-ladle. Each slice, as it is taken off, is poured along the side of the cauldron which is nearest to the operator: by this means every portion of the curd rises successively to the surface, and is sliced thin. The whole is then well stirred, and the cauldron is replaced over the fire. A long staff, with a small knob of hard wood at the end, and which has smaller cross pieces or sticks passed through holes in it at right angles to each other near the end, is now used to stir and break the curd, and the heat is raised to about 135°, which is as hot as the arm can well bear, even when used to it. The cauldron is again swung off the fire, and the curd is stirred with the staff, which is moved round with a regular rotatory motion, the knob running along the angle formed with the side by the bottom of the cauldron, which is in the form of a bowl. After stirring in this manner nearly an hour, the curd is found divided into small dies about the size of a pea, which feel elastic and rather tough under the finger. Experience alone can teach the exact feel they should have. The whey, of which a portion is removed occasionally, now floats at top, and the curd is collected in the bottom by giving a very rapid rotatory motion to the contents of the cauldron by means of the staff. A cloth is now introduced into the bottom, and all the curd collected over it; it is raised by the four corners, and laid on an instrument like a small ladder, which is placed across the mouth of the cauldron. The whey runs out through the cloth, which is a common cheese-cloth woven with wide interstices; and the curd in the cloth is placed in a shape or hoop made of a slip of wood four inches and a half wide, the two ends of which lie over each other, so that the diameter can be increased or lessened. A cord fixed to one end of the hoop is passed with a loop over hoops on the outer surface of the other end, and prevents the ring from opening more than is required. The curd is pressed into this ring with the hands, and the ends of the cloth are folded over it. A round board, two inches thick, and strengthened by cross pieces nailed on it, is placed over the curd, and the press let down upon it.

The cheese-press is a simple long board or frame forming a lever, loaded at one end and moving in a frame at the other; it is lifted up by another lever connected with it, and let down on a strong stick, which stands with its end on the centre of the board last-mentioned. Thus the weight is easily removed or replaced. The hoop containing the cheese is placed on a similar board, and from it the table of the press slopes towards a wooden trough, which receives the whey as it runs out. In an hour after this, the curd is examined; the edges, which are pressed over the ring, are pared off, and the parings are put on the centre of the cheese; a fresh cloth is substituted, and the whole cheese is turned. The ring, which opens readily by unhooking the cord, allows the cheese to come out, and is put on again and tightened. This is repeated two or three times in the day. In the evening, a small portion of finely powdered salt is rubbed on each side of the cheese, and it remains in the press till the next morning. It is now again rubbed with salt, and placed on a shelf with a loose board under it. The wooden ring remains on the cheese for two or three days, and is then taken off. This is the whole process.

During the next six or eight weeks the cheeses are turned and wiped every day, and a small quantity of fine salt is sifted on the surface and rubbed in with the hand until it will take no more. The cheese-room is always very cool, and little light is admitted. A free circulation of air is essential. The cheeses are in perfection in about six months, and will keep two years. A quantity of elastic fluid is disengaged in the ripening, and forms those round eyes which are a peculiar feature in these cheeses. The smaller and rounder the eyes, the better the cheese is reckoned. They should contain a clear salt liquor, which is called the tears; when these dry up, the cheese loses its flavour. These particulars will give any one unacquainted with the dairy a tolerable notion of the process of cheese-making in general.

In Cheshire the making of cheese is carried on in great perfection, and the greatest pains are taken to extract every particle of whey. For this purpose, the curd is repeatedly broken and mixed, the cheeses are much pressed, and placed in wooden boxes which have holes bored into them. Through these holes sharp skewers are stuck into the cheese in every direction, so that no particle of whey can remain in the curd. The elastic matter formed also escapes through these channels, and the whole cheese is a solid mass without holes, which in this cheese would be looked upon as a great defect. The salt is intimately mixed with the curd, and not merely rubbed on the outside. This checks internal fermentation, and prevents the formation of elastic matter. The whole process of cheese-making is minutely described in the *Agricultural Report for Cheshire.*

Gloucester and Somersetshire cheeses are similarly made, with this difference, that the curd is not so often broken, or the cheese skewered, and a portion of the cream is generally abstracted to make butter. After the curd has been separated from the whey and is broken fine, warm water is poured over it for the purpose of washing out any remaining whey, or perhaps to dissolve any portion of butter which may have separated before the rennet had coagulated the milk; for although cream adds to the richness of cheese, butter tends to make it rancid.

Stilton cheese is made by adding the cream of the preceding evening's milk to the morning's milking. The cream should be intimately incorporated with the new milk; great attention should be paid to the temperature of both, and much of the quality of the cheese depends on this part of the process. To make this cheese in perfection, as much depends on the management of the cheese after it is made as on the richness of the milk. Each dairy-woman has some peculiar method which she considers as the best; and it is certain that there is the greatest difference between cheeses made in contiguous dairies. The rennet should be very pure and sweet. When the milk is coagulated, the whole curd is taken out, drained on a sieve, and very moderately pressed. It is then put into a shape in the form of a cylinder, eight or nine inches in diameter, the axis of which is longer than the diameter of the base. When it is sufficiently firm, a cloth or tape is wound round it to prevent its breaking, and it is set on a shelf. It is occasionally powdered with flour, and plunged into hot water. This hardens the outer coat, and favours the internal fermentation, which ripens it. Stilton cheese is generally preferred when a green mould appears in its texture. To accelerate this, pieces of a mouldy cheese are sometimes inserted into holes made for the purpose by the scoop called a *taster*, and wine or ale is poured over for the same purpose; but the best cheeses do not require this, and are in perfection when the inside becomes soft like butter, without any appearance of mouldiness. In making very rich cheeses the whey must be allowed to run off slowly, because, if it were forced rapidly, it might carry off a great portion of the fat of the cheese. This happens more or less in every mode of making cheese. To collect this superabundant butter, the whey is set in shallow pans, as is done with milk when butter is made; and an inferior kind of butter, called *whey butter*, is made from the cream or fat skimmed off.

Cheeses are frequently coloured, a practice which probably arose from the notion of making the cheese look richer; but now it deceives no one. Yet if some cheeses were not coloured, they would not be so marketable, owing to the association that subsists between the colour and the quality of the cheese. The substance used for colouring is most commonly arnotto, which is ground fine on a stone, and mixed with the milk at the time the rennet is put in. The juice of the orange carrot, and the flower of marygold, are also used for this purpose. This last gives a more natural tint than the arnotto, which is too red. Chedder, a cheese made in Somersetshire, which is highly prized, Stilton, Derby, and some other cheeses, are never coloured: Cheshire slightly; but Gloucester and North Wiltshire deeply. Foreign cheeses are only coloured very slightly, if at all; the Dutch cheeses are made in a very similar manner to the Gloucester cheeses, but the milk is generally curdled by means of muriatic acid or spirits of salt; and great care is taken to prevent fermentation, and to extract the whole of the whey. For this purpose the curd is repeatedly broken and pressed; and before it is made up into the round shape in which it is usually sold, the broken curd is well soaked in a strong solution of common salt in water. This diffuses the salt throughout the whole mass, and effectually checks fermentation. When the cheeses are finally pressed, all the whey which may remain is washed out with the brine; salt is likewise rubbed over the outside, and they are set to dry on shelves in a cool place. The flavour of the cheese is perhaps impaired by the stoppage of the fermentation; but it never heaves, and it acquires the valuable quality of keeping well even in warm climates. From the place where this cheese is commonly made, it is known by the name of Edam cheese. A finer cheese is made at Gouda and other places, by imitating the process in making Gruyere cheese; but this cheese is always full of small cavities, and will not keep so long as the Edam. The cheese most commonly met with in Holland is a large kind of skim-milk cheese, which is made very like Cheshire cheese. It grows hard and dry, and has not much flavour. To supply this defect, cummin seeds are mixed with the curd, which those who are accustomed to it consider a great improvement. On the whole it is a better cheese than our Suffolk skim-milk cheese, and forms an important part of the provisions usually stored for a Dutch family. In France the Roquefort cheese is compared to our Stilton, but is much inferior, although a good cheese. The little cheeses made from cream and folded in paper, called Neufchâtel cheeses, are imported from France as a delicacy. They can be easily imitated, being nothing more than cream thickened by heat, and pressed in a small mould. They undergo a rapid change, first becoming sour and then mellow, in which state they must be eaten.

A small cheese, much relished by all ranks, is made in the north of Germany in the simplest manner. It is usually made from milk from which the cream has been taken off to make butter,—although the entire milk is much better. This is curdled by being placed near a fire. When it has become somewhat sour, it is put into a linen bag, and all the whey well pressed out. When it is tolerably solid, it is broken by the hand in a tub, and made very fine. It remains in this state several days, until a considerable alteration takes place, and the putrid fermentation begins, as is readily perceived by the odour. It is then taken in small portions, and formed into flattened balls three or four inches in diameter, by beating them in the hands. These balls are ranged on a board, and set to dry. A portion of carraway seed is generally mixed with the curd. In a few days the mellowing goes on, and the centre becomes very soft. In this state it is a great dainty for those who disregard a pungent and fetid smell. They are sometimes placed in the smoke of a chimney, where the putrid fermentation is checked and confined to the centre by the pyroligneous acid arising from a wood fire. They remain in the chimney a considerable time; and when they are used the outer part is peeled off like the rind of an apple. A whole cheese is a mere mouthful. It gives a relish to the sour black rye bread generally eaten by the lower orders.

The green Swiss cheese, commonly called *Schabzieger*, which is made in the canton of Glarus, and is by many persons highly esteemed, is made somewhat in the same manner. The curd is pressed in boxes with holes to let the whey run out; and when a considerable quantity has been collected, and putrefaction begins, it is worked into a paste with a large proportion of a certain dried herb reduced to powder. This herb, called in the country dialect *Zieger kraut* (curd-herb), is the *Melilotus officinalis*, which is very common in most countries, and has a peculiar aromatic flavour in the mountains of Switzerland. The paste thus produced is pressed into moulds of the shape of a common flower-pot, and the putrefaction being stopped by the aromatic herb, it dries into a solid mass, which keeps unchanged for any length of time. When used it is rasped or scraped, and the powder mixed with fresh butter is spread upon bread. It is either much relished or much disliked, like all those substances which have a peculiar taste and smell.

A species of cheese or rather hard curd is made in the mountains of Switzerland from the whey which has run from the common cheese made of the whole milk. It is called *serré*. When the Gruyere or the Jura cheese, which is often sold by the same name, has been put under the press, a quantity of fermented whey, about two or three gallons, is poured into the cauldron with the new whey, and the whole is heated over the fire till a thick scum rises. This is taken off when the whey is nearly boiling, and put into a square box with holes in it; the whey which remained mixed with the curd, and which is now very blue, is allowed to run out, and a small pressure assists it. When a cheese of sixty pounds has been made, the serré will often weigh twenty pounds. This mass of curd readily dries on the shelf, and becomes hard. It has little flavour, but it serves the people on the mountains for bread. They cut slices of it, spread some butter over, and put a thin slice of cheese upon this: washed down with a cup of fresh or of fermented whey, it forms the chief food of the mountain herdsmen. The only luxury indulged in is an occasional glass of *kirsch-wasser*, a spirit distilled from cherries, or of gentian brandy, from the root of the *Gentiana officinalis*.

When a cheese which has been much salted and kept very dry is washed several times in soft water, and then laid in a cloth moistened with wine or vinegar, it gradually loses its saltness, and from being hard and dry becomes soft and mellow, provided it be a rich cheese. This simple method of improving cheese is worth knowing. It is generally practised in Switzerland, where cheeses are kept stored for many years, and if they were not very salt and dry they would soon be the prey of worms and mites. A dry Stilton cheese may thus be much improved.

The cheese trade is one of considerable importance.

CHESHIRE AGRICULTURE.—The soil and climate of Cheshire are peculiarly well adapted for the growth of grass. The soil is mostly composed of loams of various degrees of tenacity, and the climate is moister than the more eastern parts of England. Situated in an extensive plain between the Derbyshire and Welsh mountains, Cheshire is seldom exposed to long droughts. The low meadows along the banks of the rivers are very subject to be flooded, which is one reason for keeping them in grass. Two-thirds at least of the county possesses a soil above mediocrity, of which the greater part is in permanent pasture, and produces the excellent cheese known as Cheshire cheese. The arable land is generally that which is thought too sandy for pasture, or of which the grass has deteriorated by neglect. Hence the arable part of a farm in Cheshire is seldom cultivated with that attention which is paid to similar land in those counties where good grass land is scarce. There are very few farms which consist chiefly of arable land. There is everywhere a predilection for the dairy. It may be safely asserted that with the exception of gentlemen who hold farms in their own hands, of whom there are many of considerable wealth in the county, there are few farmers who deviate from the old routine, or seem inclined to adopt improved systems of cultivation. At the same time there are perhaps few counties in England so susceptible of material improvement as Cheshire. It possesses great advantages: an easy communication by canals and rivers with the most populous manufacturing districts, and consequently a certain market for its agricultural products. According to the report to the Board of Agriculture, the county is divided as follows:—

	Acres.
Arable and meadow land, including parks and pleasure-grounds . . .	620,000
Waste lands, commons, woods (a considerable part of which has been inclosed since) . . .	28,000
Peat bogs and mosses . .	18,000
Sea lands in the æstuaries of the Dee and Mersey .	10,000
	676,000

There are many large proprietors resident in Cheshire, but the class of yeomen is much diminished, and is replaced by small proprietors, chiefly retired tradesmen and artificers, or small farmers, little raised above the common labourer.

Dairy farms require considerable buildings, and some have been erected by wealthy proprietors in the best and most substantial manner. The habitations for the family are quite sufficient for their comfort; many of the cow-houses are constructed on the Dutch plan. The heads of the cows are turned towards each other, with a passage in the middle for a small cart, by which the fodder is brought directly before the cows. It is thus given to them with greater cleanliness and economy than in any other way. Where many cows are kept, this will be found by far the most convenient arrangement of a cow-house. There is a description of one of these cow-houses in the ‘Agricultural Report of Cheshire’ (p. 84), erected at Ollerton, near Knutsford, which combines simplicity with great convenience. Large farms are not common in Cheshire. The average size may be considered as from 50 to 150 acres, that quantity being sufficient for the full employment of a family, and for a dairy of twelve to twenty cows. The rent of land is higher than that of the same quality in other parts of England, which is owing to the smaller outlay with which a dairy farm is managed. The implements of husbandry are in general such as have been in use for ages; a heavy, ill-constructed plough, drawn by four or five horses in a line, with which they plough three-fourths of an acre of the heavy loams in a day. Harrows and rollers, the latter occasionally armed with spikes, are used to break the heavy lumps which the plough turns up, when the sun has baked them. Improved instruments are in use amongst the gentlemen farmers, but their example is seldom followed by the common renters of land. The effect of the dairy husbandry may be observed all through the county. Land is ploughed in order to have winter fodder for cattle, and to improve pastures overrun with weeds. Where the land is fit for turnips, which is not often the case, they are raised for the cows. Cabbages have been cultivated with some success in several farms, but there is no improvement in the mode of cultivating corn crops. It is not uncommon to see two or three crops of oats taken in succession from newly broken up land, and the last laid down with grass seeds. In this exhausted state it produces no good grass for many years, but plenty of weeds. The introduction of a good system of convertible husbandry would double the present produce of Cheshire. But we will not venture to affirm that the dairy produce would be improved at the same time. When land is brought to a high state of cultivation, and the artificial grasses give a great bulk of fodder, the quality of the cheese is often deteriorated; or to speak more correctly, the process must be varied. It is much easier to make cheese that will keep from poor pastures than from rich.

There is a simple instrument in use Cheshire which deserves notice. It is a small strong scythe, called a hodding scythe, used to cut up rushes in pastures. It has a short handle, and the blade, which is about twenty inches long, is bent like a portion of a hoop. By a dexterous use of this instrument in spring, a man cuts up a tuft of rushes with a great portion of the roots, and as a hollow is left the water enters into the cut part of the remaining roots and rots them. The hollows should then be filled up with earth, and grass seeds sown over them.

The rushes and roots cut off are put in a heap to rot, which is readily effected by the addition of quick lime, and thus an excellent compost is formed.

The cultivation of potatoes has been much encouraged in Cheshire, by the demand in Liverpool and the manufacturing districts. In that part of the county which lies along the æstuary of the Mersey, great quantities of very good potatoes are raised. The sandy and turfy soils, which are unfit for permanent pasture, are peculiarly fitted for the growth of potatoes. The neighbourhood of Frodsham has been long noted for the great quantity of potatoes it produces. The produce on good land is upwards of ten tons per acre, but they require at least twenty-five tons of manure. The best potatoes grow on land broken up from grass, which had been laid down in a rich state; in this case no manure is required. When potatoes are very plentiful, and the price low, they are given to cattle, either boiled or raw, and in this way they are worth more than any other root, and produce much excellent manure. Early sorts are raised for the Liverpool market by a slight forcing. They are laid in a dry chamber and protected from the frost; they shoot early, and in that state, one shoot only being left, they are put into the ground in February, and occasionally protected by mats or straw. A slope of the beds towards the south-west is reckoned the most favourable exposure. They come in a month earlier than those planted at the usual time, and the land is cleared by the beginning or middle of June: a second crop is then put in, to be dug up in November. A warm sandy soil suits the early potatoes best. Near Warrington early potatoes are set in wide rows, and cabbages are planted between them: when the potatoes are taken up, the cabbages have the mould drawn round their stems, and attain a good size in spring. This is a cultivation which deserves to be more generally introduced on good strong loams.

Grass land is considered so much more valuable than arable, that most leases contain a clause, 'that not more than one-fourth of the farm shall be ploughed.' Many farms have little or no arable land attached to them. A soil which is rather stiff is considered the best for grass, especially if there be a substratum of marl, which is the case in many parts of the county. The marl, when spread over the surface, materially improves the herbage. A very rich loam is not considered so good for pastures where cheese is made, as one less fertile, as it is apt to make the cheese heave. In Nantwich, and the western part of Northwich hundred, the substratum is chiefly marl, and the soil a stiff clay.

The natural grasses found in the good pastures are chiefly of those kinds which have been most approved of for sowing, when arable land is laid down to grass; viz., Poa pratensis, Poa trivialis, Festuca pratensis, or, on sandy loams, Anthoxanthum odoratum. In the Report it is stated that Rhinanthus Crista Galli, commonly called yellow rattles, is very common in the pastures, and is said to be readily eaten by the cattle. It is in most places considered a sign of poor land, and lessens the value of the hay. The Cheshire farmers often defer mowing the grass for hay in a dry summer in the hope of having a greater crop by waiting for showers; but this is a mistake, since it is much more profitable to cut the grass, however light the crop may be, as soon as the principal grasses are in flower, when the stalk contains the most nutritive juices.

Although much of the soil in Cheshire is well suited for fruit-trees, orchards are not common: the marly substratum is not well adapted for the roots of trees; deep, alluvial, and loose soils are the best. The hedge-rows are in general well filled with trees, which gives the country, when seen from an elevation, the appearance of a continued forest. The forest of Delamere, as it is called, although, like many other antient forests, a great part of it is a mere waste without any woods, formerly contained 10,000 acres. It is now much reduced by enclosures, but a great portion is still waste.

Draining has been introduced extensively, and with the best effect, in order to carry off the superfluous surface-water, which is common in many parts of the county. The shoulder-drain is common in stiff soils. Paring and burning are not much practised, and this mode of preparing land for crops is in general reprobated by landlords as destructive of the soil; but when old worn-out pastures are overrun with bad grasses and weeds, there is no improvement more effectual.

The abundance of marl found in Cheshire is one of the chief means of improving the poor soils; 130 solid yards, or tumbril loads, of marl are put on an acre in the summer months, and left on the surface all the winter. In spring it is ploughed in, and makes the manure put on afterwards go much farther. Marling is a permanent improvement. Lime, and also sand, are put upon strong heavy lands to ameliorate the texture; the first does so, when put on in any proportions; the latter must be put in considerable quantities, and not ploughed in deep. It is a great improver of cold wet pastures, especially after they have been drained.

In the neighbourhood of the salt mines, refuse salt has been used for manure, and with success; but whether it owes its virtue to the salt, or to the earthy ingredients mixed with it, is still doubtful.

The number of rivulets in Cheshire might naturally suggest the applying of them to the purpose of irrigation; but this has been done in a few instances only.

In some places, where a rivulet could be turned, so as to flow through a farmyard, and afterwards irrigate meadows situated lower down, advantage has been taken of this, as an easy mode of conveying the manure over the grass; in this they have imitated the common practice in most farms in Switzerland.

From the great number of dairy-farms in Cheshire, one would naturally expect to see considerable attention paid to the breed of cows; but, till lately, this was not the case; there were cows of all breeds, and crossed in every possible way. The great superiority of the improved short-horn breed has however made them more generally sought after. Some of the dairies have very fine herds, or packs, as they are called there, of short-horned cows, and some of Ayrshire cows; but this is by no means yet general; purity of blood is not much thought of. When a cow is a good milker, her cow-calves are weaned; and those heifers which are raised on the farm are thought to produce the most thriving cows. A cow is considered in her prime at four or five years old, and continues so till she is ten or twelve, after which she falls off, and should be fatted for the butcher. "A good milker has a capacious and thin udder, without much flesh on it, teats standing well apart, and not too large; a deep belly, with very prominent milk veins; a light fore-quarter, wide loins, thin thigh, white horn, thin head, clean about the chaps and throat, and a full lively eye." (*Agricultural Report.*) A cow that gives much milk is never fat, and her hip-bones project: her ribs appear distinctly under the skin. It is estimated that there are about 100,000 cows in the county, each of which gives on an average 2½ cwt. of cheese in the year; that is, altogether, 250,000 cwt., or 1250 tons. Each cow gives on an average about eight quarts of milk per day; some few give much more, and even as much as twenty-four quarts per day; but this is extraordinary, and only for a short time. Four quarts of milk make one pound of cheese; it takes from twelve to fifteen quarts to make a pound of butter. A cow is in full milk for six months after calving, then three months in half milk, and three months dry. A plentiful supply of good fresh food, such as clover or tares, cut and carried to the stall, will often double the average of milk; but this is seldom practised in dairy counties. The cows are generally housed in November, or kept in yards, which is better. During the winter they are let out for a few hours each day into a paddock, or small meadow, near the homestead; they find nothing to eat there, but it gives them an appetite for their dry food when they come in again. Stall-feeding cows has been attempted, and with success; but this occasions too much trouble for the dairy-farmer, although the produce may be much increased, and the manure will amply repay the expense of the daily cutting and carrying of the fodder. Cow-calves which drop in February and March are usually reared: they are left three weeks to suck the cow, after this they have warm whey given them to drink, or oatmeal-gruel mixed with whey. Flax-seed, steeped in water until a jelly is formed, is also given them by some. For the first winter they have hay, in the next only straw. The heifers take the bull at two years old.

The making of Cheshire cheese is described minutely in the Agricultural Report for the county, to which we refer, as well as to the article CHEESE.

Butter is made from the cream or from the whole milk allowed to coagulate and become sour. Good butter may be obtained in either way; but that made from fresh cream is always the best. An inferior butter is made from the cream which rises on the whey. [BUTTER.]

A considerable part of the profit of a well-managed dairy arises from the feeding and selling of pigs; but fewer pigs are kept in Cheshire than the dairies would warrant. The fatting of calves for the butcher is probably not so profitable, from the want of demand for veal in the country, as it would be nearer the metropolis.

The wages of agricultural labourers are good on the whole, and they are in general laborious and provident. The neighbourhood of manufactures tends to raise the wages.

The sheep husbandry, which is so profitable to the farmer in other counties, is scarcely known in Cheshire. Sheep do not go well with cows, as they pick out the finest herbage before it is long enough for the cow to graze. Some few are kept to consume the grasses which the cows refuse; they are seldom kept over the year, and are sold as soon as any profit is realized.

On the whole Cheshire is inferior to many other counties in agriculture, but it contains more means of improved husbandry than most. It wants only the application of capital, and the superintendence of men of true practical science, to become one of the finest agricultural counties in England.

CHICORY is a perennial plant bearing a composite flower, which gives the name to the sub-family or section of the *chicoraceæ*, which belongs to the family *Compositæ*. It has a fusiform root like a carrot, from the crown of which large and succulent leaves spread out, with deeply indented edges. The whole plant is bitter and aromatic; and the leaves, as well as the root, have been used in medicine, in the form of a decoction, as a tonic bitter and diuretic. It is frequently used as a salad, especially when blanched. For this purpose, the roots are taken up in the end of autumn; they are then placed in sand or light mould, in a cellar from which the light is excluded, the leaves having been cut off previously within half an inch of the crown. Fresh slender leaves soon grow out of the root, and, being deprived of light, they are much more delicate and tender than those which grow in the open ground. The bitterness also is thus lessened, and they form a very pleasant winter salad, which, from the long, slender, and matted state of the leaves, the French call *barbe de capucin* (monk's beard). It is pleasanter to the taste than common endive, and stimulates the stomach by its bitter and aromatic quality.

The luxuriant growth of the leaves of the chicory, and their speedy reproduction after they have been cut, suggested the more extensive cultivation of this plant as food for cattle and sheep, who are fond of the leaves. M. Cretté de Panuel, who cultivated it near Paris in a rich soil, produced extraordinary crops. The first year he cut it only twice, but afterwards four and five times in a year: it produced more green food than any other plant cultivated for this purpose. Arthur Young was so struck with it that he strongly recommended it to the notice of British agriculturists; and in the queries sent to various parts of the country by the Board of Agriculture, one was, whether chicory was cultivated in the district as green food for cattle. But notwithstanding its abundant produce, it has not been found so much superior to other green food as to make its cultivation general. Some accurate experiments on a large scale were made in France at the national farm of Rambouillet, to ascertain the value of chicory compared with lucerne and other green food. The chicory was declared inferior, giving a disagreeable taste to milk and butter when cows are kept upon it. For sheep it is very good, and a small portion mixed with their other food may probably be a preservative against the rot.

Chicory is now chiefly cultivated in Belgium and Germany, for the purpose of preparing from the root a powder which can be substituted for coffee. This has become a very considerable article of commerce. It was very lately introduced into Britain, and the consumption of it, and consequent demand, increased so rapidly, that the government thought proper to put a check on its importation by a duty of 20*l.* per ton on the dried root.

To have the roots in perfection, the seed should be sown, or rather drilled, in April, like that of the carrot. If sown sooner, they are apt to run to seed. The land should be rich, deep, and light. The plants should be thinned out to six inches in the rows, and most carefully weeded. In September the leaves should be finally gathered and the roots taken up, which may be done with a common potato-fork. They are then cleaned by scraping and washing, split where they are thickest, and cut across in pieces about two or three inches long. These pieces are dried by means of a slow oven or a kiln. Some nicety is required in drying, to prevent the root from being scorched and to keep the proper flavour. In this state it is sold to the merchants, packed in bags. It is afterwards cut or chopped into small pieces, and roasted exactly as coffee, ground in a mill, and packed in papers in pounds and half pounds for retail sale. When coffee, as well as all colonial produce, became too dear for the labouring classes in France and Germany, chicory was almost universally used as the best substitute, and the taste is by many thought so grateful, that they prefer the coffee with which a fourth or a fifth part of chicory has been mixed. Chicory is said to exhaust the soil, and to require fresh ground to prevent its degenerating. Unless the soil is rich and light, the roots will not come to a good size in one season, and old roots become tough and stringy. It is only the young roots that are fit to be prepared for commerce. They lose a great portion of their weight in drying. The best preparation of the land for chicory is grass or clover. The manure should be laid on before it is ploughed up in autumn, which will accelerate the decomposition of the roots. The land should be ploughed very deep in spring, and laid light; the surface harrowed fine, and the chicory seed drilled in rows twelve inches apart, and rolled. Liquid manure spread over the ground will much accelerate the growth of the plants, which must be thinned out like turnips or carrots to six or eight inches from plant to plant.

CLAY is an essential component part of all fertile soils. A clay soil consists of a large proportion of alumina united to silica of various degrees of fineness, and frequently also a portion of carbonate of lime. When the silica is very fine and intimately mixed with the alumina, the clay, although stiff in appearance, is fertile in proportion to the humus which it contains, or which is artificially added to it. It then forms that class of rich wheat soils which produce many successive abundant crops without change or manure. It has a strong affinity for water, which prevents the plants that grow in it being injured by drought; and it has a sufficient degree of porousness to allow superfluous moisture to percolate without making it too soft. All that is required for such a soil is a porous substratum of rock or gravel; and where this is not the case, sufficient under-drains must be made to produce the same effect. The clay soils in Britain are not in general of this fertile kind. They are of a compact nature which retains the water; and the various oxides and salts of iron which they contain are mostly injurious to vegetation. Hence they require expensive draining, and manuring, to render them productive. This has made lighter soils, which are more easily worked, to be generally preferred, although naturally less adapted to the growth of wheat; and the mode of cultivation of the light soils has advanced more rapidly towards perfection than that of the clays. Yet the latter will undoubtedly repay the outlay best, when once they are brought to a certain state of improvement. When clay soils are well drained, and when the effect of noxious salts has been removed by liming, burning, and frequent stirring, it will be found that a much smaller quantity of manure will produce a certain return in grass or corn, than on any light soil. The great difficulty is to choose the time when stiff clays are to be worked; and here it may be observed, that ploughing sometimes does more harm than good. When clay is wet, especially in the beginning of summer, and it is ploughed in the regular process of fallowing, the tough moist slice cut out by the plough is set on edge, and the sun bakes it into a hard mass like brick. In this state it is not improved by exposure to the air, which cannot penetrate this hard substance. It would be much better to plough out deep water-furrows with a plough made on purpose, and wait until the moisture is reduced by gradual percolation and evaporation; so that the plough should raise a slice ready to break and crumble as it is turned over. This should be done immediately before winter, and then the frost will so divide and mellow the soil, that, provided it be kept free from superfluous water by under-drains and water-furrows, it will have the appearance of the finest mould when worked with the harrows in spring. To plough it again would be to spoil all. It should have received the necessary manuring in autumn, and be ready for the seed to be sown on this pulverized surface. The horses which draw the harrows or the sowing machines should be made to walk in the furrows, which should afterwards be deepened out with the spade, or by a plough constructed for the purpose. A free course and outlet should be formed for all surface water; for no maxim is more true than this, that stiff clays are never injured by a continuance of dry weather, unless they were in a wet state immediately before. The dryest clay contains sufficient water to supply the roots of plants for a long time; but wet clay in drying and shrinking destroys the texture of the roots by mechanical pressure. This may be of use when weeds are to be eradicated, and in that case a different mode of proceeding may be recommended; but when good seed is sown, the clay should be in such a state as to crumble under the harrows, and it should not be too moist. Experience has taught the ploughman, that clay soils should be laid in round lands or stitches; and much of the produce of a field depends on the skill with which this is done. It is not only the surface which should lie in a rounded form, but the bottoms of the furrows should lie in a regular curve, without small ridges or inequalities between them; so that when heavy rains penetrate through the whole thickness which the plough has raised, the water may find its way into the intervening furrows, without being retained by the small ridges left by an unskilful ploughman. It is seldom that a common labourer can be made to perceive the consequences of his carelessness. The slightest inclination of the plough to either side makes an inclination in the bottom of the furrow. An inequality in the depth does the same. The usual method is to increase the depth of the ploughing from the crown of the stitch to the outer furrow. If the land has been cross-ploughed or dragged level before the last ploughing, this may answer the purpose; but if the stitches are only reversed, and the centre of the new stitch is to be where the water-furrow was before, it requires twice ploughing to bring the stitch to its proper form, and this is not always done, for fear of treading the land too much. Hence it is always preferable, where it can be done, to lay the land flat by cross-ploughing and harrowing before it is raised in stitches. The narrower the stitches are, the dryer the land will lie. The most convenient width is five bouts, as it is called, that is, five furrows on each side of the centre, which, allowing 9 inches for each furrow, makes 7½ feet, leaving 18 inches for a water-furrow, which is deepened into a narrow channel in the middle.

We have been thus particular in describing the management of clay land, because it seems not so generally understood, and there is great room for improvement in the common modes of cultivation. Fallowing for wheat is the old system on clay soils, and continues to be so in nine farms out of ten; but it often happens that in a wet season the whole advantage of the repeated ploughings is entirely lost, the land sown with wheat is neither enriched nor improved by all the tillage bestowed upon it, and is as full of weeds as it was when first broken up from the preceding stubble. The better system is to clean the land well in summer, after it has borne a crop of winter tares, which have been cut green or fed off by sheep in May or June, and to lay it up high and dry for the winter, after having given it the proper liming and manuring; to sow it with oats and grass-seeds in spring, keep it in grass as long as is convenient, and break it up in autumn. Wheat may then be sown; or it may have the benefit of another winter's frost, and beans may be drilled or dibbled early in spring. After harvest the bean stubble may be cleared with harrows or scarifiers, and the seeds allowed to vegetate; the plough will then destroy them. A good crop of wheat may be depended upon after this, if the land is in good heart; if not, it should have been manured for the beans: but if the grass was fed off the preceding year, and the land well managed before, it cannot fail to be in good heart. Clay land will bear a repetition of the same crops much oftener than lighter lands; but every scientific agriculturist knows the advantage of varying the produce as much as possible, making plants of different families succeed each other. The cereal grasses are of one family, which is the reason why wheat, barley, oats, rye-grass, &c. do not succeed so well after each other as after leguminous plants or clover, and that turnips, besides cleaning the land by the repeated hoeings given them, are so good a preparation for corn. A good rotation for stiff clays is yet a desideratum in agriculture; and although we will not affirm that fallows can be entirely dispensed with, we are persuaded that they might be separated by much larger intervals than is usually done. And if advantage is taken of early seasons, at least in the southern parts of the island, most lands may be kept clean by what is called a bastard fallow immediately after harvest, without losing a crop. We will go farther, and assert that instead of three crops in four years, which is the common method, and an improvement on the old system of two crops and a fallow, five might easily be obtained, especially if tares and trifolium incarnatum are considered as crops. For example: 1. Oats or barley; 2. Clover; 3. Wheat; 4. Trifolium cut in May, and succeeded by spring tares, cabbages, or potatoes. At all events the trifolium or winter tares may always be had in the year in which the land is to be cleaned by repeated ploughings; as they may be cut early in summer, and leave ample time for the operations.

The most profitable management of a stiff wet clay soil, after thorough draining it, is to cultivate it on the convertible system; that is, to have it three years in grass and three years under the plough, unless a permanent and good sward can be obtained upon it, in which case it will give the surest return by remaining in grass. A preliminary course of cropping with ample manuring will so much improve the texture of the surface, that a much better herbage will grow upon it; and when this is well established, it may be left so until it degenerates.

The great disadvantage of clay soils in a moist climate like that of Great Britain arises from an excess of water, and the obvious remedy is perfect draining of the subsoil. This is effected by numerous hollow drains judiciously arranged to convey the water to a proper outlet. An instrument has been lately invented or improved by which this is done effectually, and at a comparatively small expense. [Draining.]

Clay is extensively used in many parts of England to improve light land, by being carried on the surface in considerable quantities, but this is chiefly where it approaches to the quality of marl, by having a considerable portion of calcareous earth in its composition.

The effect of burnt clay as a manure has been highly extolled, and not without some reason in particular situations. Clay by burning alters its nature; it becomes insoluble in water, and loses its attraction for it; it then resembles siliceous sand, and may greatly improve a very strong retentive clay, tempering it and rendering it more porous. To burn clay, it is dug out in lumps and dried;

heaps are made of these at regular distances in a field, with a small cavity in the centre, in which dry furze and brushwood are introduced. This being lighted, the fire is allowed to burn very slowly, and the smoke kept in by adding a sod or clod wherever it bursts out. When the heap is once burning, more clay may be added, even without being dry, and the combustion goes on without other fuel. It must be so managed as to bake the clay without heating it too much; and when the heaps are cooled and opened the whole should appear pulverized, and of a red colour if oxide of iron exists in the soil. A coat two or three inches thick spread over a field and ploughed in will greatly improve its texture; but sufficient animal or vegetable manure must be added to make it fertile.

CLOVER, a name given to different species of Trifolium. Dutch clover is T. repens; purple clover is T. pratense; cowgrass, or perennial clover, is T. medium.

Clover was introduced into the agriculture of Great Britain about the sixteenth century, from the Low Countries, where it had been long cultivated as green food for cattle in situations where natural pastures were scarce. It was the first step towards the improvement of the old triennial system. Its abundant produce, its destruction of annual weeds, which it smothers by its broad foliage, and especially the beauty of the wheat sown after it, soon recommended it as an indispensable part of an improved rotation of crops. It is not too much to say, that the profit of any farm may be considered as proportionate to the quantity of clover which is produced upon it on an average of years. There are various kinds of clover, which all go under the botanical name of trifolium, from the three leaves which grow together, or rather the form of the leaf, which has three heart-shaped parts. They are annual, biennial, or perennial plants. The annual clovers, with the exception of the trifolium incarnatum (*Trèfle incarnat* or *farouche*), introduced from the south of France, are not so generally cultivated as the biennial, which produces a greater crop, and being sown along with the spring corn comes up the first year under its shade, and gives a full crop in the second. In good land it will sometimes stand another year, but it falls off in quantity; and unless other artificial grasses or perennial clovers have been sown amongst it, to fill up the places where the biennial clover has failed, it is seldom profitable to allow it to remain on the ground more than one year after that in which it is sown.

The most approved variety of the biennial clovers is the common red or broad clover (*Trifolium pratense*), which is usually sown with barley or oats, or sometimes among wheat or rye in spring. When these are drilled and hoed there is an advantage in sowing the clover-seed among a crop which is already advanced in growth, because it is kept under, and there is no danger of its injuring the chief crop by its too great luxuriance. There is, however, some risk of the clover not coming up so well, if the wheat or rye is very close on the ground. In Scotland clover is often sown among wheat, in Norfolk invariably with barley, and in Belgium among rye. This depends on the various rotations adopted in different countries. The first crop is generally mown and made into hay. In this process great care is taken not to break off the tender leaves of the plant in drying; the swarth is not shaken out as is done with meadow grass, but merely turned over; and if the clover can be dried and put in a stack without any shaking, it is so much the more valuable. When clover is soaked with rain, no hope of an improvement in the stack must induce the farmer to carry it together, so long as the least moisture remains. If it is allowed to stay in the field till it is perfectly dry, even when it has been soaked repeatedly and is nearly black, and is then trod hard in a rick with a sprinkling of salt over each layer, it will be readily eaten by cattle in winter, and be far more nutritious than that which, having been stacked in a moist state, will infallibly come out musty. A very good method in those seasons when a continuance of dry weather cannot be reckoned upon—particularly when the second crop is cut in September—is to take advantage of two or three dry days to cut the clover, and turn it as soon as the dew is completely dried off the upper side; the next day do the same, and in the evening carry the green dry clover and lay it in alternate layers with sweet straw, so as to form a moderately sized stack. A fermentation will soon arise, but the dry straw will prevent all danger from too much heating, and, acquiring the flavour of the clover, will be eaten with avidity by the cattle. To those who make clover-hay for the use of their own stock in winter, we recommend this as preferable to the common method, even when there is less danger from the weather. In northern climates it would probably save the crop two years out of three.

It is usual to sow rye-grass (*Lolium perenne*) in a small proportion with clover seed, especially where clover, having been often repeated on the same land, is apt to fail. It is a good practice; and although in the neighbourhood of London the unmixed clover obtains a better price, there is no reason why it should be preferred, unless the rye-grass has been allowed to stand too long and has grown hard. Young rye-grass is a good corrective of the heating qualities of clover-hay. A very extensive use of clover-hay in London is to cut it into chaff, and to mix this with oats and beans for dray horses, which have little or no hay given them in any other way; but the most profitable use of clover is to cut it green for horses and cattle. With a little management and the assistance of tares, green food may be given to all the stock from the first day of May to the end of November.

The land which has borne clover, although in a very good state for producing corn, will not bear a repetition of that crop until several other crops have intervened. In the regular Norfolk rotation, clover should recur every fourth year; but after a few rotations this is found to be too quick a recurrence, and other grass seeds or pulse are substituted. The Flemish do not sow clover again on the same ground sooner than in eight or ten years.

The white or Dutch clover (*Trifolium repens*) is a perennial, which grows rapidly, and forms excellent pasture; but its bulk is not sufficient to make it profitable to mow it for hay. It is excellent for sheep, which thrive well upon it. A light calcareous soil is best adapted for white clover; but it also grows well on heavy land, provided the bottom be sound and dry. When land is laid down for permanent pasture, white clover is always sown in a considerable proportion with other grasses.

Another perennial clover, called cow grass (*Trifolium medium*), is found in all rich meadows: it is often sown in conjunction with the white clover in laying down arable land to grass. The lesser yellow trefoil (*Trifolium minus*) and the hop trefoil (*Trifolium procumbens*) are also valuable varieties found in good pastures.

The only annual clover which is cultivated is the French clover (*Trifolium incarnatum*), mentioned before. It is a most valuable addition to the plants usually sown for fodder, from the short time in which it arrives at perfection if sown in spring; so that where clover has failed, this may be sown to fill up the bare places. Its principal use is to raise very early food for ewes and lambs, which it does with very little trouble or expense. Immediately after harvest the stubble is scarified and harrowed so as to raise a mould; the trifolium is sown at the rate of 16 to 20 lbs. per acre, and well rolled in. It springs up and stands the winter well, and with the first genial weather in spring it grows rapidly. It makes excellent hay, and what is left produces seed most abundantly in the end of May or beginning of June, being off the ground in good time to plough the land and clean it for turnips. It is far superior to stubble turnips as an intervening crop, and more rapid in its growth than tares. On light land a crop of buckwheat is readily obtained after it. It has the property of smothering annual weeds by its rapid growth, and for this reason is not so well adapted for sowing with a crop of corn. The Italian rye-grass (*Lolium perenne Italicum*) may be sown with it, and will grow as rapidly. After the Trifolium has been cut, this will continue and give an excellent second crop. It is advisable to have fresh seeds from southern climates from time to time, or it will probably become later every year by assimilation to the climate. English seed of the first year after importation seems the best, being heavier and more free from weeds than the foreign.

Some agriculturists have objected to the practice of sowing clover with a crop of corn; they prefer hoeing the intervals between the rows of the drilled crops, by which the weeds are better kept down. They plough the land immediately after harvest, and harrowing it well, they sow clover and grass-seeds, which come in nearly as soon the next year as if they had been sown in the preceding spring: and the land, when broken up, is in a much cleaner state than if the clover had been sown with the corn. If this be not an improvement in the system, it is at least worthy of notice, and experience alone can decide whether the additional expense of ploughing is repaid by the improvement in the crop.

In France and in the United States of North America gypsum is considered as a specific manure for clover. It is sown by hand over the plant in spring, and in some situations the advantage is evident, in others scarcely observable. The quantity used is from three to eight bushels of finely powdered gypsum per acre.

On good land an acre of clover will produce as much as three tons and a half of dry hay; that is, two tons the first cutting, and one and a half the second. Greater crops are obtained on very highly manured land. The value of a ton of clover-hay to feed horses with is about 15 or 20 per cent. more than good meadow-hay. It is not however so good for milch cows. The price in London is from 4*l.* to 5*l.* per ton on an average.

When clover is intended to be left to ripen its seeds, it should be mown early, or fed off by sheep in May. The first crop is seldom free from various seeds of other plants which rise among the clover: by feeding it down or mowing it these are destroyed, and the clover, which grows more rapidly than most other plants, rises again without any mixture of weeds. When the blossom is thoroughly withered, and the seed is nearly ripe, the clover is mown and left to dry on the ground without much shaking. In very dry weather it may be housed or stacked in a week; but the process is much retarded by showers and want of sunshine. It is therefore only in the drier parts of the island that clover-seed repays the expense and risk of cultivation, especially as it is well known that the subsequent crop suffers if the clover is allowed to stand for seed. It is seldom therefore that more seed is saved, even in the most favourable situations and seasons, than is required for the farm or immediate neighbourhood. The demand from the North, where clover is sown to a great extent, could not be supplied without a considerable importation from abroad: and this has caused an outcry against the duty of 20*s.* per cwt. on foreign seed, as a tax on agriculture. Notwithstanding this high duty, the importation of clover-seed from Belgium and Holland is very considerable, as it is more advantageous to purchase foreign seed than to raise it; except in the case of the Trifolium incarnatum, which produces early and abundant seed. Foreign clover-seed should be well examined when it is purchased, as it frequently contains the seeds of docks and other noxious weeds. The usual mode of doing this is very simple. The thumb is moistened and pressed on the sample, some of the seeds adhere, and when it is turned up the quality is distinctly seen by the colour and plumpness of the seeds. If any seeds of weeds are in it, they must be detected after a few insertions of the thumb. As the calyx of the flower of clover envelops the seed closely, it is difficult to separate them. In Holland they have various machines for this purpose, one of which consists of two fine-rodded hurdles made to rub on each other whilst the heads pass between them. In England it is generally thrashed on the floor. But if the heads, after being separated from the halm, are put together in a heap and pressed, a slight fermentation takes place, and this makes the calyx brittle, so that it breaks into dust, and the seed comes out readily · it is then easily cleared by the fan.

When the seed is not intended for the market, the trouble of clearing it of the husk may be saved, especially in the Trifolium incarnatum. It will grow as well when sown with the husk as when cleaned;

and it is easy to find the proportion required to be sown in that state by allowing for the weight of the husk.

COLE, COLZA, a cultivated state of the *Brassica Napus*, which does not form a close head, like cabbage, but has sessile heart-shaped leaves. It is cultivated for its seeds, from which an oil is expressed, which is much used for burning in lamps, and in the manufacture of leather and soap.

There are two varieties of cole, one with white flowers and another with yellow; the latter is the hardiest, and consequently most generally cultivated.

It requires a good loamy soil, well manured, to produce a good crop of coleseed. In rich land lately broken up from pasture, or fenny land newly drained, it grows luxuriantly and gives a great return. It is thought to be a great exhauster of the soil. In a rotation, cole is considered as a good crop to precede wheat. Like rape, which is another variety, it is sometimes sown to be fed off by cattle and sheep on land which is not so well adapted to the growth of turnips.

COMMONS are wastes and pastures which have never been exclusively appropriated by any individual, but used in common by the inhabitants of a parish or district. Where extensive common rights exist, the mode of cultivating the inclosed land is greatly affected by it. All the cattle being maintained on the commons for a great part of the year, less land is laid down to grass, and only so much is kept in meadow as will produce hay to feed the cattle in winter weather, and when the commons will not sustain them. The consequence is, that the arable land is not well cultivated, little manure is made in the yards, and the rent is paid by the stock which runs on the commons, and which increases and grows without any expense to the owner. But it is a wasteful disposition of the land. Common pastures are never improved; no one will drain or clear them of weeds, still less manure them. The stock kept upon them is not by any means so numerous as could be kept on the same surface divided and improved. Hence most of the commons and common fields in Great Britain have been divided and inclosed within the last forty years. Wherever an inclosure has taken place the public has gained, even when the individuals immediately connected with the land may have suffered some loss, by not receiving an equivalent for the profit they had from the cattle which they contrived to keep on the commons.

The soil of commons within a manor belongs to the lord: if there is no manor, it belongs to the king. The herbage belongs in general to the tenants and other inhabitants of the manor or districts, according to fixed rules. Where commons are very extensive there is sometimes no restriction on the number of cattle which may be turned out on them. This is called *common without stint.*

The usual proportion given to the lord for his right in the soil on an inclosure is one-sixteenth. The remainder is divided among those who have a right of common in proportion to the land they possess, and on which their right depends.

Common fields differ from commons, in that they are divided for the purpose of cultivation; but as soon the crop is off the ground, the cattle of all the proprietors, or of all the parishioners, as the custom may be, have a right of pasture over the whole in common. This system is incompatible with an improved husbandry, and common fields have been very generally divided and inclosed by particular acts of parliament. A late act greatly facilitates these inclosures, and will no doubt soon convert every remaining common field into inclosed farms.

COPPICE, a wood or plantation of various kinds of trees, which shoot up from the root when cut down, and which are periodically cut down before they acquire any considerable size. The most common trees planted or used for this purpose are the oak, the chestnut, the maple, the birch, the ash, and the willow. The hazel and the alder are also frequently planted in coppice, the former in dry and chalky soils, the latter in moist and marshy situations. Timber trees are generally allowed to grow in coppice, or more properly the coppice is the underwood where timber is the principal object. There is a doubt, however, whether it is judicious to allow many trees to stand where there is a ready sale for coppice wood. The quick return of the latter overbalances the greater price of old timber. In consequence of this opinion, large trees fit for ship-building, which require a long time to arrive at the required size, are become very scarce; and many woods, once thickly studded with majestic trees, are reduced to mere coppice-wood. The value of a well-managed coppice is considerable where the produce can be readily manufactured into useful articles, and carried to a good market. Ash hoops, hop-poles, chestnut gate-hurdles, and sheep-hurdles are the principal articles manufactured or prepared in a newly-cut coppice. What is of no use for these purposes is made into faggots for fuel, where this is scarce, or converted into charcoal, which is more easily transported. A good coppice will bear to be cut down every eight or nine years, and will thus be worth, according to situation, from 6*l.* to 15*l.* per acre, or even more, when sold to those who undertake to cut and prepare the wood.

Little attention is generally paid to the coppice except when it is fit to be cut, but this is a great mistake: with a little attention a coppice may be doubled in value in a few years. It should be carefully drained where the water has not a ready outlet. Where the most profitable kinds of wood are deficient fresh plants should be supplied. The whole should be kept well stocked, but not overstocked; and the pruning-knife should be used where it appears necessary, especially where hop-poles are in request, which usually bear a good price. Hop-poles require a longer time to attain the proper size, and more room to grow. For this purpose the coppice may be thinned out, without being entirely cut down. When a coppice is cut, attention must be paid to the manner in which the poles and rods are cut off from the stem. They should be divided by a clean slanting cut with a very sharp axe or bill-hook, so as not to shatter the stump which is left. The wound will then soon heal over, and the stump will not be injured by the wet, and decay, as is too often the case. When fresh ground is planted for a coppice, it should always be previously trenched and drained. The extra expense of this will soon be repaid. Scotch firs may be planted at first as nurses and shelter to the oaks and other forest trees. In seven or eight years the firs will have acquired a considerable height and may be thinned out or cut down: they never shoot again from the root. The other trees may be left to grow a few years longer before they are cut down. After the first cutting, attention must be paid to the stumps and all superfluous shoots removed. In seven or eight years a thick coppice will be formed, which will increase in value every time it is cut, and will produce a very good annual rent for land which would not have been profitable in cultivation, either as pasture or arable farms. The annual expense of a coppice is trifling, and the regular returns are certain and profitable. When a portion of coppice is cut every year, so as to have a regular rotation, the income is as regular as that of any other part of an estate. A proportion of coppice on an estate is essential to the production of game and to its preservation.

The ground most favourable for coppice is that which is too steep or rocky for cultivation, and where the climate will not allow of the vine. Where the land is flat, and can be well drained, arable farms will always be most profitable, unless in some poor sandy soils, where corn will not grow without extraordinary manuring, while the roots of some kinds of trees will sink to a great depth and find there the nourishment necessary to their growth. In such sandy soils the birch, the maple, and the acacia sometimes grow luxuriantly, when the grass on the surface scarcely shows signs of vegetation. On wet and boggy soils the willow and the alder are almost the only trees that will thrive. Whoever plants a coppice must be well acquainted with the soil to a considerable depth, and must choose his plants accordingly.

CORNWALL AGRICULTURE.—Cornwall being situated between two seas, is more subject to variations of weather than most other counties; the mountains attracting the clouds, charged with moisture, which the prevalent west winds bring from the Atlantic. From this cause the harvest is not in general so early as in the more inland counties, which are in a more northern latitude by two or three degrees. The soil of the mountainous districts is extremely barren and unproductive; but in a few of the vales a tolerably rich soil is found, well adapted to the growth of corn, roots, and artificial grasses. The substratum of the whole county being rocky, and slate being the predominating rock, the surface consists chiefly of an argillaceous earth produced by the decomposition of the slate, mixed with various portions of vegetable matter accumulated in the course of ages. This soil is not naturally stiff or retentive of moisture, but rather a loose and porous soil. Excess of wet will sometimes convert it into a soft mud, where the substratum is not sufficiently porous to allow the water to percolate freely; but generally the land is not of a cold wet nature, like the clays in the midland counties. The most fertile lands are found from Endellion to St. Columb, on the north coast, in the peninsula which terminates in the Lizard Point, the neighbourhood of Burian and St. Germain's, the lands near the Fawey, and a great part of the hundred of Stratton. The rest of the county is comparatively barren. As may be expected from the nature of the soil, there is no great extent of natural meadows, and the want of them is made up by laying down part of the arable land with artificial grasses. This, however, is not done in the perfect and profitable manner adopted in the northern part of Britain; but the second or third crop of corn has grass-seeds sown amongst it when the land is nearly exhausted and full of noxious weeds. The scanty pasture thus produced is neither profitable to the farmer, nor does it serve to restore much fertility to the soil. The system of paring and burning the surface is adopted after the land has been some time in pasture; and with the help of sea-sand, which contains a great portion of comminuted shells, sea-weed, lime, and occasional manuring with pilchards, the land is brought into a state in which it may bear two or three moderate crops of corn. This at least is the old Cornish and Devonshire system, and is still adhered to by many.

Amongst the varieties of grain raised in Cornwall, we may notice the naked barley, which is there called *Pillez*. It is sown in the western part of the county for the purpose of fattening pigs and poultry, and likewise for making gruel to fatten calves. It bears nearly the same price as wheat. If the word be of Cornish origin, as is asserted, meaning *bald*, it would indicate that this variety of barley, highly praised by the French agriculturists under the name of *orge pillet*, has been originally introduced into France from Cornwall. It is highly productive, and well worthy of being introduced into other parts of the country.

The soil and climate of Cornwall are peculiarly favourable to the growth of potatoes, of which two abundant crops are sometimes produced in one season, an early crop taken up in June, and a second in October. The early crop has been known to produce one hundred sacks per acre, and the second or main crop twice that quantity. This of course was in a deep and highly-manured soil. In many leases the farmer is restricted from growing potatoes except for his own use, than which nothing can be more absurd, as it deprives the farmer of a means of paying a higher rent, and cultivating his farm to advantage. The only condition should be the purchasing lime and manure in proportion to the potatoes raised and sold.

The principal cattle in Cornwall are of the Devonshire breed. The old Cornish breed, which was a small black mountain breed, is nearly extinct, as are likewise the small Cornish sheep: they have been superseded by better breeds. In no county are oxen more generally used for the plough than in Cornwall. Horses were formerly used only to carry loads on their backs. Good roads and the use of carts and waggons are comparatively new improvements, and by no means general. But there is a very simple and light wain peculiar to this county, which is deserving of notice. It has no sides like a waggon, but hoops over the wheel to keep the load from impeding their motion. It has some distant resemblance to the light waggons used in the mountainous part of Switzerland. The implements of husbandry are either of a rude construction or adopted from other districts. The Cornish plough is simple, and has a straight mould-board: where four or six oxen are put to a plough, the draught is not much considered. To prevent the breaking of the beam, in case stones are met with under the surface, the oxen are attached by a wooden pin, which breaks on any sudden check, acting as a kind of safety-valve.

Leases are generally for three lives, renewable on the death of one of the lives by paying a fine; a kind of tenure between a renter and a proprietor. A term of years is preferable, as being more certain. Farms let at a rack-rent are let for seven, fourteen, and twenty-one years, as in other counties.

The county is rather bare of trees. Forests probably once existed, but they have now disappeared. Young plantations are much exposed to the sea-winds, except where sheltered in valleys. Many proprietors, however, have planted on a large scale; and forest trees are beginning to rear their heads on many eminences, to the great improvement of the face of the country.

In the mining districts the land is naturally barren; but many spots have become clothed with verdure, and are cultivated by the miners, to whom spots of barren soil have been let at a low rent, on condition of their building habitations for themselves and families.

Improvements in agriculture are chiefly introduced by proprietors who occupy their own land. The common farmers, who are not men of capital nor enterprise, prefer following the routine of their forefathers. Large commons give a facility for keeping cattle without much expense, and this is seldom favourable to an industrious cultivation of arable land.

The county is, however, advancing slowly but steadily towards an improved system of cultivation.

COUCH-GRASS (*Triticum repens*) is a common and most troublesome weed which infests arable land, especially that which is of a light and mellow nature. It is perennial, and propagated both by seed and by extension of the root, which is long and jointed; each joint produces a fresh shoot, which, in a favourable situation, soon becomes a new parent plant, creeping along under the surface of the ground, and spreading over a whole field with great rapidity. It appears above ground like a blade of grass or young wheat, which, in its tender state, is readily eaten by sheep. A seed stem afterwards shoots up, bearing a spike, composed of a middle rachis and alternate floscules on each side. Each of these produces three or four seeds, protected by a long pointed chaff. Many of the seeds never come to perfection, owing to the increase of the roots, but in stiff ground and permanent pastures the roots are prevented from spreading, and then the seeds ripen. The principal propagation of the plant is by the root. The destruction and extirpation of couch-grass is one of the first things which an experienced farmer sets himself to on taking occupation of land which has been neglected by the preceding tenant.

There is no law in this country which obliges a tenant to keep his lands free from weeds. There is something of the kind in Belgium with respect to thistles and weeds which propagate by seed. An agricultural code is necessary to protect the landlord, and to prevent the woful waste of labour produced by carelessness and bad management: and until such a code is established, agriculture will never make rapid progress.

To extirpate couch-grass a dry time must be chosen in summer; the land must be ploughed with a deep furrow to bring the roots to the surface: when the land is dry, it must be rolled to break the clods, and all the roots which lie near the surface must be gathered by the harrows or the couch rake. Sometimes the roots are matted into tufts, which can only be got up by means of a fork or prong. In this case no manual labour should be spared, especial care being taken not to break the roots, but to get them out whole, with all their offsets, if possible. After this, Finlayson's harrows, described in ARABLE

Land, may be used on light lands; or an instrument of a similar nature, called, from the shape of the tines, a *cat's claw*, and in Scotland a *grubber*, which will bring up all the roots that are within nine or ten inches of the surface. When all the couch has been apparently eradicated, there will still remain a sufficient number of pieces and joints, broken off by the instruments and left in the ground, to produce a fresh crop of couch grass, especially if the land is frequently stirred, and showers intervene. Hence the vulgar notion that some lands breed couch, and that it is useless labour to be at much expense to eradicate it. Such lands should be laid down with artificial grasses and kept in grass for several years, being depastured with sheep and cattle in preference to mowing them for hay.

In this case the couch-grass will spring up above ground and gradually disappear, and when the land is broken up again not a vestige of it will remain. After this it may be kept clean for many years by hoeing and weeding.

In very stiff soils, as in Kent, the couch-grass is got rid of by ploughing very deep and burying it eight or nine inches under the surface. For this purpose the furrow slice must be large, and turned completely over, not merely set on end, as is often the case. The old turn-wrist plough, drawn by four horses, does this most completely, and this is the principal reason why many practical farmers in that county prefer this ponderous and clumsy instrument to lighter and more scientific ploughs. In very heavy land couch-grass is easily kept down if an opportunity be taken to plough it to the surface in dry weather. The stiff clods in which the roots are entangled contract in drying, and in contracting destroy the texture of the root; when they crumble after a shower the couch may be collected by hand and burnt or carried away. If the method of ploughing it in is preferred, it should be done by trench ploughing, by means of two ploughs following each other in the same furrow. The first may go six or seven inches deep, and the second four or five; thus the couch-grass will be buried much deeper than with one ploughing, and four horses with two men will do the work well, which will not be much more expensive than the turn-wrist plough, with four horses, a man and a boy. This can only be done to advantage in deep soils, such as occur in a few counties only.

When a quantity of the roots of couch-grass has been collected, they are usually burnt in heaps on the ground: the ashes serve to enrich the land in some degree, but a much more profitable use may be made of them. When they are cleaned from the earth which adheres to them, they are found to be nutritious and farinaceous. Pigs eat them greedily; horses and cows will also eat them, especially when boiled or steamed; and weight for weight they contain not much less nutritious matter than potatoes; it is downright waste therefore to burn them. By maceration and washing, a good fecula is obtained, which, with hot water, forms a jelly like arrow-root. The decoction of the root has been recommended as a cooling and demulcent beverage, and not without apparent reason; but if it be not thought worth while to wash and steam the couch for food, it is still more profitable to decompose it by means of lime than to burn it. For this purpose it should be gathered into a large heap and watered to induce fermentation. When it has heated, it should be turned over and mixed with quick-lime in a considerable proportion: after two or three turnings with the spade, with an interval of a few weeks, it will be found converted into rich mould, which may then be spread over the land, either as a top-dressing for clover and artificial grasses, or ploughed in with the seed, where this method is practised.

To keep the land free from couch-grass occasional summer tillage is necessary, which may be given when turnips are sown, or after an early crop, such as tares cut green, Trifolium incarnatum, or winter barley, without losing a crop. In a well-managed farm couch-grass should no more appear than docks or thistles. In Belgium a slovenly farmer is called a couch grass farmer.

Dogs eat the blade of couch-grass from instinct to purge and vomit, and hence it has been named, in French, *chien-dent*, or *dog's-tooth;* but the shape of the young shoots from the root may also probably have led to that name, for they have a great resemblance to a canine tooth.

It has been doubted whether, in some situations, couch-grass might not be cultivated to advantage for its roots: no experiments, however, have been made in cultivating this prolific plant, as far as we know; but it is not unworthy the attention of those who take a pleasure in increasing the resources of agriculture. In years of great scarcity the root of couch-grass has been used, in northern countries, mixed with flour, in making bread. It contains nothing unwholesome, and has a considerable resemblance in taste to the potato. The water in which the root of couch-grass has been boiled may be used in the manufacture of bread; it would probably add considerably to the weight of the loaf when baked, but may perhaps communicate an unpleasant taste to it.

COW, one of the most useful of the domestic animals: her milk is peculiarly adapted to nourish infants and invalids, and requires no preparation to make it palatable or wholesome. In the article CATTLE we have given an enumeration of the various breeds of cows; and under BUTTER and CHEESE an account of their principal produce. We shall here confine ourselves to the proper management of a cow, so as to make her most productive; and to the most common diseases to which this animal is subject.

Where only one or two cows are kept, especially where they are to be maintained on a limited portion of pasture, it is of great importance that a good choice be made when they are purchased or reared. Some breeds no doubt are much superior to others; but as a general rule, there is a better chance of having a profitable cow, if she be reared on the land on which she is to be kept. When the common breed of the country is decidedly inferior, it may be profitable to bring a cow from a distance, in which case it should be from some district of which the pasture is rather inferior to that to which she is brought, or at least not better. The best breeds are found in the richest pastures, but they do not thrive on worse. On poor land a small active cow will pick her food and keep in condition, where a fine large cow would starve, or at least fall off rapidly. This is particularly the case in the mountains, near the tops of which no domestic animal will live but the goat, and next to it the smallest breed of cows. Where the pastures are poor but extensive, cows give little milk, and the number which can be kept must make up for the produce of each. Where, on the other hand, cows are stalled, as in Flanders, and fed on artificial food brought to them in sufficient quantity, large bulky cows give the best return for the food; at least this seems to be the opinion of the Flemish farmers in general. In France, where the cows are led along the roads to pick up the herbage growing by the road-side, or are tethered on a small portion of clover or lucerne, a small lean cow is preferred; and in general the cows commonly met with, and which are bred in each district, seem the best adapted for the mode in which they are fed. Whatever be the breed or quality of a cow, she should always have plenty of food, without which no considerable produce in milk can be expected. This food should be succulent as well as nourishing, or else fat will be produced instead of milk. A cow well fed may be safely milked till within a month of her calving. It is better that she should be dry before the new milk begins to spring in her udder. A little attention will readily prevent her becoming dry too soon, or being milked too long. Heifers with their first calf should be allowed to go dry sooner than older cows; because their growth would be impeded by the double drain of the milk and the calf. It is best to let a heifer go to the bull when nature prompts her to it, provided she be not less than fifteen or eighteen months old; for if they are thwarted in their first heat, they are apt to become irregular ever after; and it is advantageous for a cow to calve regularly at the same season of the year. The best time is May, when the grass begins to be succulent. In some countries, such as Switzerland, the cows calve regularly in April or May, and are then sent to the pastures among the mountains. The calf is killed almost immediately, unless it be reared for stock, veal being of little value. In populous countries where veal is considered a luxury, the calves are kept and fattened by letting them suck the cows, or by giving them warm milk to drink. Near large towns this is a profitable mode of employing the milk, when it cannot be sold for immediate consumption. [CALF.]

A cottager with two or three acres of moderate land may keep a cow, and thus add much to his earnings as a labourer. For this purpose he will require a small portion of permanent grass fenced off, to allow the cow to take exercise, which is necessary to her health. Her food must be raised in regular succession, and cut for her. The earliest green food is rye; then tares; then clover, which may be made so to succeed each other as to give an ample supply. Cabbages, beet-root, parsnips, potatoes, and turnips, will continue the supply during winter; and the dung and urine of the cow, carefully collected, will be sufficient to keep the land in condition. This system, lately introduced into some parts of Ireland, has already greatly improved the condition of the industrious poor. There is very good advice on this management in Cobbett's *Cottage Economy*, a useful little publication.

Where cows are allowed to be in the open air, with proper shelter in case of stormy and wet weather, they are subject to few diseases. They must be carefully looked to at the time of calving, but except in urgent cases nature must be allowed to perform her own office. A little common sense and experience will soon teach the possessor of a cow to assist nature, if absolutely necessary; and in case of difficulties the safest way is to call in an experienced person. Drinks and medicines should be avoided; a little warm water, with some barley or bean meal mixed with it, is the most comfortable drink for a cow after calving. The calf, and not the cow, should have the first milk, which nature has intended to purge its intestines of a glutinous substance which is always found in the new-born calf. A very common disease with cows is a disordered function of the liver, producing a yellowish tint in the eyes, and sometimes in the skin. A gentle purge, consisting of half a pound of Glauber salts, an ounce of ginger, and two ounces of treacle, with two quarts of boiling water poured over them, may be given when it is milk-warm, and repeated every other day; keeping the cow warm, if it be in winter, by a cloth over the loins, and in a shed. This will in general restore her health. Should the cow appear to have a chronic affection, the safest course for a cottager is to part with her at any price to those who may be better skilled in curing diseases; for it is seldom that a cow is worth the expense of the farrier's attendance in such cases. The symptoms of a diseased liver or lungs in a cow are leanness, with a staring coat, a husky cough with loss of appetite, a difficulty of breathing, and a great diminution in the secretion of the milk. The first loss by the sale of the cow is always the least in the end. In accidents, or acute diseases, the attendance of a clever veterinary practitioner is indispensable.

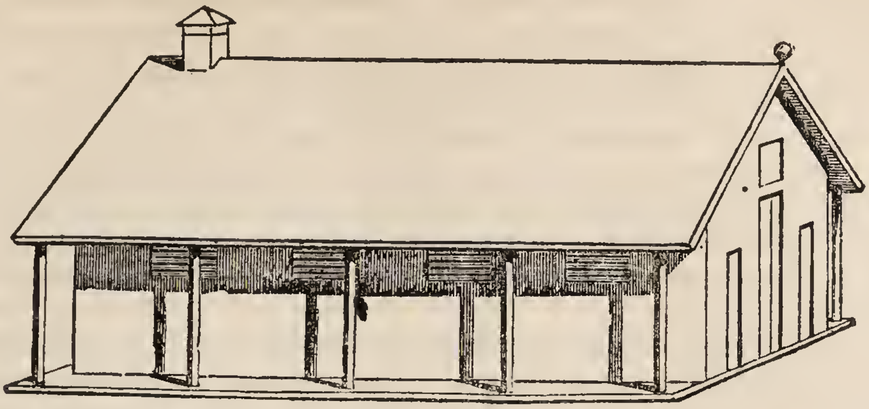
Nothing is more prejudicial than the idea that medicines are necessary to keep cows in health; and the practice of keeping advertised medicines at hand to give to an animal whenever it is fancied to be ill is very detrimental to their health. Attention to food and exercise, giving the first regularly and in moderate quantities at a time, and allowing the cow to use her own judgment as to the latter, are the great secrets of health; and a healthy young cow reared at home, or purchased of a conscientious dealer, will probably live to old age without ever having had any disease. A cow is old and unprofitable when she reaches twelve or fourteen years. She should then be sold and a young one purchased. If the cottager have the means of rearing a cow-calf to succeed the old mother, he will do well; if not, he must lay by a portion of the cow's produce every year to raise the difference between the value of the old cow and a young one. The saving banks are admirable institutions for this purpose: a few shillings laid by when the produce of the cow is greatest, will soon amount to the sum required to exchange an old one for a younger.

DAIRY, the name usually given to the place where the milk of cows is kept and converted into butter or cheese. The occupation is called *dairying;* and land which is chiefly appropriated to feed cows for this purpose is called a *dairy-farm.*

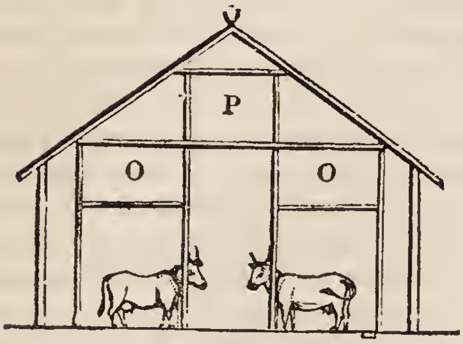
A dairy-house should be situated on a dry spot somewhat elevated, on the side of a gentle declivity, and on a porous soil. It should be on the west or north-west side of a hill if possible, or at least sheltered from the north, east, and south, by high trees. In some countries where there are natural caverns with an opening to the west, and springs of water at hand, the best and coolest dairies are thus prepared by nature. Artificial excavations in the sides of freestone rocks are sometimes formed for the purpose of keeping milk, and more frequently wine. Where no such natural advantages exist, the requisite coolness in summer, and equal temperature in winter, which are essential in a good dairy, may be obtained by sinking the floor of the dairy some feet under ground, and forming an arched roof of stone or brick. In cold climates flues around the dairy are a great advantage in winter; and an ice-house in warm summers is equally useful. But these are only adapted to those dairies which are kept more as a luxury than as an object of profit. In mountainous countries, such as Switzerland, where the summers are hot in the valleys, and the tops of the mountains or high valleys between them are covered with fine pastures, the whole establishment of the dairy is removed to a higher and cooler atmosphere, where the best butter and cheese are made. Coolness is also produced by the evaporation of water, an abundant supply of which is essential to every dairy. It is also a great advantage if a pure stream can be made to pass through the dairy, with a current of air to carry off any effluvia, and keep the air continually renewed.

As the milk suffers more or less from being agitated, or too much cooled, before it is set for the cream to rise, the cow-house or milking-place should be as near as possible to the dairy, or rather it should be under the same roof. The milk may then be brought immediately from the cows, without being exposed to the outer air. The dairy-house should consist of three distinct apartments below, with lofts and cheese-chambers above. The principal place is the dairy, properly so called, sunk two or three feet below the level of the ground, with a stone or brick bench or table round three sides of it to hold the milk pans. This table should be a little below the level of the outer soil. Air-holes covered with wire should be made in the walls a little above, and on the opposite sides of the dairy; and they should have shutters sliding over them to open or shut according to the weather. The floor should be of stone or paving tiles, sloping gently towards a drain to carry off the water. Great care should be taken that no water stagnates in this drain, which must be kept as clean as the floor of the dairy, and not communicate with any sink, but run out into the open air: a declivity from the dairy is essential for this purpose. If this cannot be obtained, it must run into an open tank, and the water be regularly pumped out. The windows of the dairy should be latticed. Glazed windows may be added for the winter, but they should always be open except in very hot or very cold weather. There may be shutters to close entirely, but this is not essential. If the windows are made like venetian blinds, the light will be excluded without excluding the air. The utmost purity must be maintained in the air of a dairy; nothing should enter it that can produce the slightest smell. No cheese or rennet should be kept in it; and particularly no meat, dressed or undressed. Even the dairy-maid should avoid remaining longer in it than is necessary, and should at all times be extremely clean in her person.

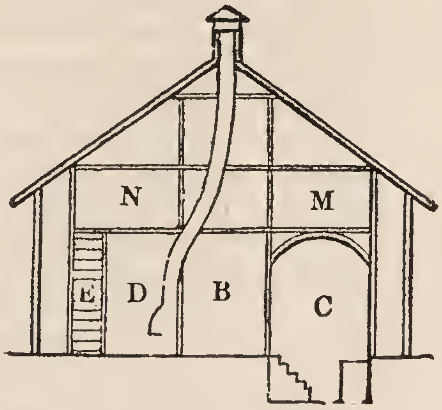
The next important place is a kind of wash-house, in which there is a chimney where a large copper kettle hangs on a crane to heat water in, or milk when cheese is made. In countries where wood is scarce, and pit-coal is the common fuel, a copper may be set in brick-work with a grate under it, as is usual in England. In this place all the utensils of the dairy are kept, and scalded with boiling water every day. It should have an outer door, which may be to the south, and benches outside on which the pails and other utensils may be set to dry and be exposed to the air. Between the two last apartments may be another communicating with both, and forming a kind of vestibule, where the churning may take place; and over them a cheese-room and lofts, or any other useful chambers. A verandah round the dairy is very convenient, or on three sides at least. It shades from the sun, and adds to the warmth in winter; and the utensils may be dried and aired under it even in rainy weather. Gentlemen's dairies are often built expensively, and highly ornamented; but they seldom unite all the conveniences essential to a good dairy, because the architects who plan them are seldom practical farmers. They are generally too far from the cow-houses, which might be joined to them without detracting from the neatness of the structure. A dairy-house placed near a mansion, and at a distance from the farm-buildings, is quite out of its place. In Switzerland and in Holland, the cow-house and dairy often have a very neat appearance within a short distance from the principal residence. The plan in both countries is very similar; the style of the roof is the chief difference. It is taken from the common dairy-farms in Holland, where the farmer and his family live under the same roof with his cows. In the Netherlands, especially in North Holland and Friesland, a cow-house is as clean as any dwelling-house, and the family often assemble and take their meals in it. The following description of a cow-house and dairy under one roof combines all that is useful, with considerable neatness internally and externally:—It is a building about sixty feet long by thirty wide, with a verandah running round three sides of it. The dwelling is not here attached, as it usually is in common dairies, and the building is not surrounded by a farm-yard: these are the only circumstances in which it differs from that of a common peasant. The dairy-room is sunk below the level of the soil, and is paved with brick. The sides are covered with Dutch tiles, and the arched roof with hard cement. The cow-house, like all in Holland, has a broad passage in the middle, and the cows stand with their heads towards this passage, which is paved with clinkers or bricks set on edge. Their tails are towards the wall, along which runs a broad gutter sunk six or eight inches below the level of the place on which the cows stand. This gutter slopes towards a sink covered with an iron grate, which communicates by a broad arched drain with a vaulted tank into which all the liquid flows. The gutter is washed clean twice a day before the cows are milked. The cows stand or lie on a sloping brick floor, and have but a small quantity of litter allowed them, which is removed every day and carried to the dung-heap or to the pig-sties to be more fully converted into dung. Whenever the litter is removed, the bricks are swept clean; and in summer they are washed with water. In Holland the cows' tails are kept up by a cord tied to the end of them, which passes over a pulley with a weight at the other end, as we see practised with horses that have been nicked: thus they cannot hit themselves, or the person who milks them. The manner in which the cows are fastened is worthy of notice:—Two slight pillars of strong wood are placed perpendicularly about two feet distance from each other, so that the cow can readily pass her head between them. On each of these is an iron ring, which runs freely up and down, and has a hook in its circumference: two small chains pass from these hooks to a leather strap, which buckles round the neck of the cow. Thus the cow can rise, and lie down, and move forward to take her food, which is placed in a low manger before the two pillars; but she cannot strike her neighbour with her horns. The mangers or troughs are of wood, or of bricks cemented together, and are kept as clean as all the rest of the cow-house. In Switzerland the cow-houses are similar, but there is also a rack, the back of which towards the passage shuts up with a board on hinges. The Dutch mode supplies more light and air to the middle passage; and as the food is given frequently and in small quantities there is very little waste. The following cuts will give a tolerable idea of



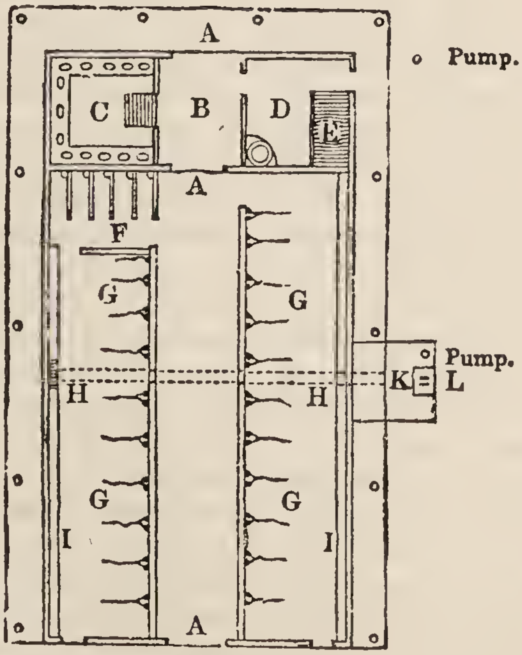
Side view.



Section of a Cow-house.



Section of a Dairy.



Ground Plan.

A, A, A, passage through the cow-house and dairy, ten feet wide, paved with bricks set on edge or Dutch clinkers. The food is brought in this passage in a small cart and distributed to the cows.

B, part of the above passage closed in with doors and forming a vestibule to the dairy.

C, dairy-room, in which only milk, cream, and butter are kept. It is sunk three feet under the level of the cow-house, and covered with a brick arch; it has one latticed window, and several ventilators, on a level with the place on which the milk vessels are set.

D, the room where the utensils are scalded, and where cheese is made; in one corner is a fireplace, with a large kettle or a copper set.

E, stairs to go up to the cheese-room M, and loft N.

F, calf-pens, in which the calves are tied up to fatten, so that they cannot turn to lick themselves; a small trough with pounded chalk and salt in each pen.

G, the place for the cows, without partitions; each cow is tied to two posts by two small chains and two iron rings, which run on the posts. The chains are fastened to a broad leather strap, which is buckled round the neck of each cow. H, H, two sinks, with iron gratings over them, to catch the urine from the gutters I, I, which run all the length of the cow-house on each side. K, the urine tank, vaulted over with a door L, to clean it out, and a pump to pump up the liquid manure. O, O, in the section, are places where the green food or roots are deposited for the day's consumption. P, a hay-loft.

the whole arrangement. The food is brought in carts, which are driven at once between the cows. What is not wanted immediately is stored above, whence it is readily thrown down before the cows. Thus much trouble is saved, and one man can feed and attend to a great many cows. From November till May the cows never leave the cow-house. In summer, when the cows are out, if they are in adjacent pastures, they are driven home to be milked; but if the pastures are far off, which is sometimes the case, they are milked there, and the milk is brought home in boats; but this is not thought so good for the butter, which is then always churned from the whole milk, without letting the cream rise. The finest and best flavoured butter is always made from the cream as fresh as possible; and to make it rise well, the milk should be set as soon as it is milked, and agitated as little as possible. The greatest quantity is seldom obtained when the quality is the finest. When great attention is paid to the quality, the milk is skimmed about six hours after it is set; and the cream taken off is churned by itself. The next skimming makes inferior butter. These particulars are mentioned to show the necessity there is of having the dairy as near as possible to the cow-house.

The utensils of the dairy, such as pails, churns, vats, &c., are usually made of white wood, and are easily kept clean by scalding and scouring. Leaden troughs are used in large dairies; and if they are kept very clean by careful scouring, they answer the purpose better than wood. They may be so constructed that the milk may be let off gently before the cream, which is collected by itself. This saves all the trouble of skimming. Brass pans have the advantage of being readily warmed on a chafing-dish in winter. In Devonshire tin or brass pans are frequently used instead of earthenware. Although there is some danger in the use of brass utensils, very little attention will obviate it. It only requires that they should be kept bright, in which case the smallest speck of oxide or verdigris would be perceptible. In Holland the milk is invariably carried in brass vessels. Cast-iron pans have been invented, which are tinned inside. They are economical; but there is nothing better or neater than well-glazed white crockery-ware, of the common oval form. Some recommend unglazed pans for summer, but they are difficult to keep sweet, as the milk insinuates itself into the pores, and is apt to become sour there.

The most common use of cows is to supply butter and cheese [Butter and Cheese], and sometimes to fatten calves [Calf] for the butcher; but the most profitable dairy is that which supplies large towns with milk. In these dairies the system is different. The cows are mostly kept in stalls, and fed with food brought to them. Some dairymen near London possess several hundred cows, and the arrangement of their establishments is worthy of notice. The cows are bought chiefly in the north, before or after they have calved. They are seldom allowed to go to the bull, but are kept as long as they can be made to give milk by good feeding. When they are dry, they are often already sufficiently fat for sale, or at all events they soon fatten, and are sold to the butcher. A succession of cows is thus kept up, new ones arriving as others are sold off. The women who purchase the milk from the dairyman and carry it about for sale, come for it to the dairy and milk the cows twice a day; and as they well know that the last drop of milk is the richest, the cows are sure to be milked quite dry, an essential thing in a dairy. An accurate account is kept of the quantity which each woman takes, which is paid for weekly. When there is more milk than there is a demand for, it is set, and the cream is sold separately, or made into butter; but this is seldom done to any extent. The cows are fed on every kind of food that can increase the milk: brewers' grains and distillers' wash are preferred, when they can be obtained. The grains are kept in large pits, pressed close and covered with earth, under which circumstances they will remain fresh a long time. Turnips and beet-root are used in large quantities; but hay is given sparingly. The cows are generally placed in pairs, with a partition between every two pair. Each cow is fastened to the corner of the stall, where she has a small trough with water before her: thus they cannot gore each other with their horns. The great dairies about London are kept very clean; but the liquid manure, which would be so valuable for the market-gardens, is lost, and runs off by the sewers. In Belgium the urine would be contracted for at the rate of 2*l.* per cow per annum, which would produce 1200*l.* a-year in a dairy of 600 cows, and would pay a good interest for the money expended in constructing large vaulted cisterns under each cow-house.

The dairy farms of England are chiefly in Gloucestershire, Devonshire, and Cheshire. They require a smaller capital than arable farms of the same extent; the chief outlay is the purchase of cows. The rent of good grass land is generally higher than if it were converted to arable land; and the risk from seasons, and from a variation in the price of the produce, is much less in a dairy farm than in one where corn is chiefly cultivated. Hence the rents are better paid, and there are fewer failures among the tenants: but the profits of a dairy farm, without any arable land, are not considerable; a decent livelihood for the farmer and his family is all that can be expected. There is no chance of profit in a dairy of which the farmer or his wife is not the immediate manager. The attention required to minute particulars can only be expected in those whose profit depends upon it. The dairies of men of fortune may be arranged on the best and most convenient plan, and be indispensable articles of luxury; but the produce consumed has always cost much more than it could be purchased for. A proper attention to keeping correct accounts of every expense will convince any one of this truth. In a dairy farm the great difficulty is to feed the cows in winter. It is usually so arranged, that the cows shall be dry at the time when food is most scarce, and they are then kept on inferior hay, or straw, if it can be procured. It is a great improvement in a dairy farm if it has as much arable land attached to it as will employ one plough, especially if the soil be light; but the mode of cultivating this farm must vary from that of other farms, since the food raised for the cows must be a principal object. Corn is a secondary object; and the cultivation of roots and grasses must occupy a great portion of the farm. When the grasses degenerate, a crop or two of corn is taken, and the rotation is chiefly roots, corn, and grass cut for hay, until it wears out. If the roots are well manured, the land keeps in excellent heart. The old pastures are kept for summer feeding. Where there is no arable land near a dairy farm, it deserves mature consideration whether it will be advantageous or not to allow some of the pasture to be ploughed up. It is often a dangerous experiment where the soil is naturally heavy, which is the case with most dairy farms in England. Arable land laid down to grass for the purpose of the dairy seldom produces fine-flavoured butter or good cheese; but clover-hay is excellent for young stock, or to fatten off the old cows. Lucern is reckoned to make cows give very good milk: nothing however can equal a rich old pasture, as all dairymen agree.

In hiring a dairy farm, it is an object of great importance that the buildings be situated near the centre of the land, and that they be well constructed and convenient. The nature of the feed must be ascertained by experience. It is often impossible to say by mere inspection whether a pasture will make good butter or cheese, especially the latter. But those which have no great reputation may often be highly improved by draining, and also by weeding, a thing too much neglected in pastures.

DERBYSHIRE AGRICULTURE.—On the high hills and moors of Derbyshire the cultivation is not extended as it might be; and there are great tracts of rough pasture of no great value in their present state, which with a moderate outlay might be improved or converted into arable land, as has been done in similar situations in Scotland. In the valleys, or on the less abrupt hills, a very fertile red marly loam is frequently met with, which is suitable for every kind of grain without any extraordinary tillage. Of this kind are the lands about Barton, Blount, and Ash, and in several places in the southern and eastern part of the county. The soil on the surface naturally partakes of the nature of the rocks which are found immediately below it; and where any particular stratum rises to the surface, or crops out, as it is called, the soil is chiefly made up of the same earthy substances, which have been more or less decomposed by the action of the air and mixed with vegetable matter. An account of the different soils is given in the Agricultural Report of the county, by Farey, of which the following table forms an epitome, distinguishing the strata from which they are formed and the number of acres in extent:—

	Acres.
Gravelly soils . .	77,000
Red marl soil . .	81,000
Yellow limestone soil .	21,580
Coal-measure, upper part	30,000
,, lower part	60,000
Gritstone and shale soils	160,500
Mineral limestone & toad-stone soils . .	51,500
Fourth limestone soil .	40,500
Total surface . .	522,080

Most of these soils may be ranked among the clays and loams of various degrees of fertility, there being but a very small proportion of sandy soils in Derbyshire. Where these occur, they are mostly alluvial, apparently washed out of the loam and brought together by currents, or the decomposition of the grit and micaceous sandstone in the grit or limestone shale.

The climate of Derbyshire varies according to the situation and height of the land above the level of the sea. The quantity of rain that falls in the mountainous parts is much greater than that in the low country: at Chatsworth, for instance, the annual fall of rain is about 28·41, and at Derby 24·77 inches. In the valleys it differs little from the surrounding counties. The time of harvest is rather late in exposed situations, and is frequently much protracted by abundant rains in the month of October; it is therefore of great importance to sow as early as the season will permit, so as to have the corn ripe in time to gather it in before the autumnal rains.

The manner in which the soil is cultivated varies as much as its nature. Rich proprietors who have experienced bailiffs adopt all the new improvements, and their farms are well managed. There are also a few farmers who have some capital and manage their land well; but the majority are small farmers, who follow the routine of their forefathers, and have not the means, if they had the inclination, to make permanent improvements. A great many farms might be doubled in value by judicious draining, and lands made to produce turnips which now are thought too heavy and wet for this useful root. The pastures also might, in many places, be greatly improved by underdraining, and rendered much better adapted to feed sheep. A common obstacle to improvement is the want of leases; for although tenants are seldom removed if they pay their rents, and it is not unusual for a tenant from year to year, when he dies, to give possession of the farm to his widow or one of his children by a testamentary bequest, which is generally respected by the landlord, the rent may be raised, if the estate comes into other hands, and the money laid out on improvements by the tenant may be the cause of this rise. Tenants from year to year are therefore satisfied with a bare livelihood, and have no motive to improve their farms. Many farms are so small that they are scarcely superior to cottage tenures, and the occupiers have other means of gaining a livelihood besides their land. In the neighbourhood of Derby and other manufacturing towns, as also near the most productive mines, some small portions of land are neatly cultivated, in a great measure by the spade, and are consequently very productive. They are let at higher rents than the quality of the soil would otherwise warrant.

The course of cultivation on the best loams is generally that which begins with a summer fallow manured with lime for wheat, and succeeded by spring corn with or without clover or grass seeds. Some farmers have adopted the improved convertible system, and find the superiority of it in point of profit, uniting the advantages of a dairy with those of an arable farm. Spring wheat has been introduced instead of barley on the best soils, and the land is laid down with grass seeds in the first crop after the fallow, or the turnips, where these are introduced.

The wheat produced on the red land is good and heavy. On the poorer soils oats and barley are more certain and profitable crops. When the wheat has failed during the winter, and looks poor and thin in spring, it used to be a common practice to sow barley amongst it; the mixed produce was called *blend*, and ground to a coarse meal, of which bread was made to the labourers. Spring wheat has been found a better substitute, and blend is now seldom met with. Haver cake made of oatmeal is still a common bread of the labourers, although wheaten bread is now very generally preferred.

Potatoes are raised in considerable quantities, both in garden plots, and in the fields, where they are planted in rows and moulded up with the plough. The produce on good loams well manured, especially on land ploughed up from grass, is very great. Six hundred bushels per acre is not thought a very extraordinary crop in very superior soils. They are given to cattle, as well as used for human food.

A large proportion of the lands is in permanent pastures, of which some are very rich. Derbyshire cheese is noted as of a good quality, and the best is often sold for Cheshire or Gloucester when made of the shape and colour of these cheeses. The common Derbyshire cheese is not generally coloured. It resembles some kinds of Dutch cheeses, and keeps well.

There are some very highly productive meadows along the course of the rivers in this county, but an improved system of embankment and irrigation is still wanting in many favourable situations. The meadows along the Dove and other rivers are from their situation very subject to sudden floods, which endanger the safety of the cattle grazing in them. To obviate this, mounds of earth have been raised in many places, to which the cattle may fly for refuge; but a judicious embankment would be much more useful, by keeping the waters within proper channels, and would allow the admission of the water by flood-gates, when it is advantageous to the land.

When the upland pastures are mown for hay, they are also called meadows. Some of these are very rich, and will fatten the heaviest oxen; but the generality of the hilly pastures are below the medium quality of pastures in England. They might be much improved by draining and weeding, which is seldom attended to.

There are many woods and coppices scattered through the county. There being no great demand for fire-wood in a country abounding with coal, the coppices are allowed to grow for twenty or twenty-five years before they are cut, in order that the poles may acquire a considerable size, and be proper for supporting the roofs and sides of excavations in mines and coal-pits, or fit to make ladders of. A good coppice of twenty-five years' growth may be worth from 25*l.* to 50*l.* per acre to cut for the above purposes, leaving a sufficient number of trees and poles at each cutting to keep up the timber growing, which when felled will be worth as much as the underwood. Many young plantations have been made of late years, and are in a thriving state.

The horned cattle of Derbyshire have no peculiar character. The various improved breeds are met with in the richer pastures, and hardier animals on the mountains: the same may be said of the sheep. The sheep on the hills are similar to those found on the Cheviot Hills; in the valleys the Leicester and South Down breeds, and various crosses, are generally preferred by the best farmers; but the quantity fatted is not so great as would be the case were the land better adapted for turnips.

The Derbyshire breed of horses is good, and many are bred in this county which are fitted for the carriage and the saddle, as well as for the farm, and form an important article in the profits of some of the larger farms.

DEVONSHIRE AGRICULTURE.—The lower hills which occupy so large a part of the surface of this county are covered with grass; the higher with moor and rock. The county contains along its numerous rivers many fertile meadows, some of which are only imperfectly irrigated, and others not at all. Grass seems to be the natural produce of a mild moist climate, like that of Devonshire, in which corn is everywhere a secondary object. The improvements in the cultivation of arable land which have been rapidly introduced into other counties, especially in the north, have not been so favourably received in Devonshire. The oldest system of Devonshire cultivation is a rude species of convertible husbandry, very different from what is called by that name in the north of England and south of Scotland. When grass land begins to wear out by injudicious management, or from a natural defect in the soil, the surface is pared thin, and the sod when dried is burnt in heaps. The ashes thus produced stimulate the soil and enable it to bear a few crops, frequently three corn crops in succession. When the land is thus nearly exhausted, it is laid down again in grass without much care, and is pastured for eight or nine years, when the same process is repeated. This system is so common in Devonshire, that the operation of paring and burning is frequently called *Devonshiring*, or contracted, *Denshiring*. Opinions differ very much on this practice: there are soils and situations where burning may be extremely useful, by improving the texture of the soil, and destroying weeds and insects; and the practical result proves that it has its advantages: but in other circumstances the burning does harm, and reduces the soil to a state of great sterility, after having stimulated it to produce one or two crops. It is becoming less common every year, and there is no doubt but in due time it will be confined to land abounding in vegetable matter in that state in which it is not fertile, as in peat or turf.

The soil of Devonshire consists of the substance of the rocks of which the hills are composed, which are granite, grauwacke, red sandstone, slate, and marble. The decomposed slate gives the argillaceous part, which binds the siliceous and calcareous sand produced from the other rocks. The waters have mixed these substances in every proportion, but the best and most fertile soils are composed of a mixture in the proportions which form a good sound loam very favourable to the growth of wheat and of potatoes. A great part of North Devon is above mediocrity as to fertility, and portions of the southern part of the county are highly productive. Considerable wastes and heaths have been gradually brought into cultivation; and although many wastes and commons still remain, and there are extensive moors and bogs scarcely susceptible of improvement, the quantity of land which is productive in grass or corn is very considerable for so hilly a country. The grass land occupies more than four-fifths of the soil under cultivation. Where an improved system of husbandry has been introduced, chiefly by resident proprietors, a regular course of crops is adopted; but the old Devonshire farmer takes three, or a least two corn crops after breaking up a pasture, and a small portion of turnips or potatoes, and has no regular rotation. After the surface is pared and burnt, lime is used for manure, and earth from banks and hedge-rows, mixed with the ashes. For turnips and potatoes farm-yard dung is used. When the sod is not burnt, the land is ploughed up in autumn or in spring, cross-ploughed in May or June, then cleared of weeds, which are burnt, and then limed and manured: thus a tolerable preparation for wheat is produced. In some situations where shelly sea-sand can be procured, it makes an excellent dressing for the land: 160 horse-loads, or *seams*, as they are called, of 2½ cwt. each, are mixed with 40 or 50 bushels of lime for an acre. When the soil is strong, and the land is ploughed from a state of pasture for immediate sowing with wheat, the seed is frequently covered by the hack, a kind of heavy hoe like a shipwright's adze. The furrow-slices are laid on edge in ploughing, and the wheat falls in between them: the hacking fills up the intervals, and the wheat comes up in regular rows. This is a very old mode of cultivation, and common in different parts of the Continent. If the land has been well prepared, it is a method of covering the seed preferable to harrowing it in, but it is more expensive. The practice of shovelling out the intervals between the stitches to cover the seed with the earth taken out, is common and much to be commended.

The rapid growth of weeds in the climate of Devonshire renders all the corn crops very foul, even after a good fallow. This should have pointed out the advantage of the row culture, which admits of hoeing the crops; but drilling is not yet introduced to any extent. Great expense is bestowed in hand-weeding, where attention is paid to having clean crops: where this is neglected, the return is much below what might be expected from the soil.

Some of the lands on the hills are so steep that the crop must be brought home upon horses, who carry a pack-saddle with large hooks on each side, in which the sheaves are laid. A horse so loaded looks at a distance like a little moving stack, being almost entirely covered with sheaves.

A considerable quantity of potatoes are raised in Devonshire and sent to London, where they obtain good prices: they were formerly planted in lazy-beds, as in Ireland, but the superior method of single rows moulded up is now very generally adopted. The rich brown loam on a rocky subsoil, which gives a dry sound bottom, especially if it has been for some time in grass, whether pared and burnt, or only ploughed and well worked, produces an abundant crop of very good potatoes. An acre well cultivated and manured will give from 300 to 400 bushels of potatoes for twenty planted.

Grass land being far more abundant in Devonshire than arable, butter, cheese, and live stock may be considered as the chief agricultural produce for exportation. The finest and richest meadows are situated on the alluvial borders of the principal rivers. These ought never to be ploughed up, although this is sometimes done, especially near the end of a lease, if not prevented by a restrictive clause. When such lands are ploughed, sudden floods sometimes destroy the crops, and carry off the finest particles of the soil. Where the meadows are irrigated they are worth from 2*l.* to 3*l.* per acre, and will produce two tons of hay per acre after having been fed off till May-day. The upland meadows are less productive, and require occasional manuring. They will produce from 20 to 30 cwt. of superior hay for horses by being shut up in March. The rent of these is from 30*s.* to 40*s.* per acre. The average quality of good upland pastures, whether of old grass or newly laid down, is such as will feed a cow of nine stone per quarter on two acres for five months, and two sheep per acre for the remaining seven. When the land has been much exhausted by corn crops, the grass seldom continues good beyond the first or second year, when it shows the mischief that has been done by the appearance of poor weak grasses which succeed the clover and rye-grass.

The clouted cream of Devonshire is a well-known delicacy. It is made by heating the milk on the hearth, or by means of a stove, to a degree a little below the boiling-point, when the clouted cream rises to the top like a thick scum, and is taken off when cooled. This cream being merely stirred briskly with the hand or a stick, is converted into butter. It is universally admitted that the butter thus produced is inferior to that which is made from the cream which has risen slowly and spontaneously, and in all the largest and best dairies in the vale of Honiton the cream is never clouted, except to be eaten in that state as a luxury.

The cows used for the dairy are almost exclusively of the breed of the county, and of a red colour. They are handsomely shaped, and some of them give much good rich milk. In general, however, they have too great an aptitude to become fat to be good milkers. A good Devonshire cow gives three gallons of milk a day, which will make twenty ounces of butter, for the first twenty weeks after calving: after this the milk gradually decreases, till, at the end of nine months, she goes dry. Thus the average produce per cow of a whole dairy through the whole year will not be more than half this quantity, even if all the cows are good, which is seldom the case. Cheese is made of skimmed milk, and is consequently inferior in quality. Where porkers are in request, as near great towns, they are profitably fattened on the skim-milk, or on the whey, with the addition of meal.

A great many oxen are reared and annually exported from all parts of Devonshire, but chiefly the northern parts. About Barnstable and South Molton the best breeds are met with. The North Devon oxen are famed for their docility and activity at work, and especially for their great aptitude to fatten. They are peculiar in form, and easily distinguished from all other breeds. The breed which resembles them most is the Sussex, but the latter are coarser in the limbs and horns, and have not that peculiar colour of the muzzle and round the eyes, which marks the North Devon breed. The cows of the pure North Devon are chiefly kept to breed: for the dairy they are improved by a cross with a short-horn. Some very fine cows of a mixed breed may be seen in the neighbourhood of Exeter, and along the whole vale of the Exe, fine in the coat, horn, and bone, and short in the legs. A cow bred from a North Devon by a Yorkshire bull, produced regularly twenty-four quarts of milk per day for five months after calving, and for several years; but the milk was not quite so rich as that of the pure breed, twelve quarts producing only one pound of butter, while eight quarts of the milk of the pure Devon cow made the same quantity.

The sheep fed on the hills and wastes of this county are of a peculiar breed, with fine wool and excellent flesh. The Exmoor sheep are extremely hardy, and well adapted to cold bleak mountains. The wethers at three years old, when fatted, weigh 12 or 15 lbs. per quarter, and the fleece from 4 to 7 lbs. In the valleys some remarkably fine sheep of an improved breed, as far as wool and carcass are concerned, have been produced by crosses of the native sheep with the Leicester. The wet state of the low meadows is not favourable to the breeding of sheep, although they fatten rapidly on water-meadow grass. The higher pastures are consequently resorted to for breeding flocks, but it requires a hardy race to withstand the wet and cold winters on the Devonshire hills; for frost is not so hurtful to lambs as continued rains. The pasture on Dartmoor Forest is very good, and the rot is almost unknown there. In order to avoid the danger of the rot, which is prevalent in the lower pastures, the sheep are often left too long exposed to the autumn rains and mists on the hills, and consequently lose much of their condition.

The following table, taken from the Report of the county by Vancouver, may be interesting to the breeders of sheep:—

The race of pigs in Devonshire is very good generally; and in some districts, where care has been taken to select the best animals and cross the breeds with judgment, as fine hogs are fatted as in any part of England.

The extremely prolific nature of the pig makes it an easy task to improve the breed by selection and crossing. A very few years' careful observation will enable any intelligent farmer to keep only the most profitable breeds. In less than a year the result of any cross is known; and when a hog twelve months old, and put up to fatten for three months, pays amply for his food, the farmer may be contented with the manure for his profit. But some breeds pay more than this; and the porkers fed with the offal of a dairy often give a profit which forms a very important item in the balance of accounts. To prove this it is only necessary to look at the account of the receipts and expenses of a dairy-farm as given by the reporter, p. 233, where it will be seen that out of a profit of 88*l.* 4*s.* 9*d.*, that upon pigs alone is reckoned at

NATIVE BREEDS.	Age of wethers, when killed, in months.	Average weight per quarter in lbs.	Average weight of fleece in lbs.	Condition of Fleece.	Comparative value of Fleece.	Rough fat in lbs.	Kidney fat in lbs.	Total inside fat.
Exmoor horned, white legs and face, with a moderately long staple of wool, pure	30	15	7	Yoak.	5*s*.10*d*.	7	5	12
Dartmouth, ditto dito	30	16	8	ditto	6 8	8½	6	14½
South Devon nott, brown face and legs, long wool, pure	30	22	10	ditto	8 4			
Bampton nott, white face and legs, short wool, pure	20	22	6½	ditto	5 5	10	7	17
	32	28	8	ditto	6 8			
CROSSED BREEDS.								
Old Leicester crossed with Bampton	24	30	10	ditto	8 4			
Ditto with Exmoor	36	24	6½	ditto	5 5			
New Leicester crossed with Exmoor	24	18	6½	ditto	5 0			
South Devon	20	20	8½	ditto	7 1			
Bampton	20	24	8	ditto	6 8	13	8	21
Merino crossed with Exmoor	..	..	5	Washed.	10 0			

25*l*., which is almost one-third of the whole.

The land in Devonshire is held in fee or on lease for lives. Where the owner or lessee on lives grants a lease, the tenant, according to the length of his tenure, may make improvements; but where the chief lessee has an uncertain tenure, and the land is underlet at rack rent from year to year, no improvement can be expected. The practice of letting farms at a nominal rent for three lives, or for a long term, often induces a man without much capital to offer a great price for a lease, which he has not the means of making profitable by good cultivation. A lease for fourteen or twenty-one years to a man who possessed an adequate capital, at a full rent, with proper restrictions to secure good cultivation, would be more likely to improve a property, and in the end would be much more lucrative both to the landlord and the tenant.

The farm buildings in Devonshire are frequently very inconveniently situated with respect to the farm. The object seems to have been to choose a sheltered spot, without regard to the situation of the land attached to the farm.

The materials of which the buildings are constructed are stone or earth, made into a species of mortar, and formed into thick walls, which dry and harden gradually, and are called by a provincial term, *cob* walls. Of this material, houses, barns, granaries, and especially garden walls are made; it is in some respects similar to the *pisé* of the south of France; but in this last no water is used, whereas the cob walls are made in a moist state, and harden by drying. If the wet is kept off by a good coat of plaster and a projecting roof, a cob wall will last many generations.

The farms are not so extensive as in the more level parts of England; 150 to 200 acres, of which at least three-fourths are pasture, are considered a large farm. The extensive commons and wastes, where cattle can be turned out for a mere trifle, even if no common rights can be claimed, tend to increase the number of small holdings: a farm of fifty acres of grass land can maintain a great number of cattle, when they are out of it for seven months in the year.

There are also in this county many more small proprietors and lessees for ninety-nine years, which is nearly the same, than in most other parts of Britain. They are mostly frugal and industrious, and if they do not cultivate their land in the most approved manner, they at least contrive to live comfortably. This is chiefly owing to the rearing of cattle, which requires constant attention, and the eye of the master, much more than the cultivation of the soil, and in which small occupiers are generally more successful in proportion than large farmers.

The chief beverage of the Devonshire people is cider, which is here superior to any other in England. The soil on the slopes of the hills is peculiarly adapted to the growth of fruit-trees, especially on a loose rocky bottom, where the roots may insinuate themselves and find moisture at all times. The fruit-trees in many parts of the county give a stranger the idea of forest-trees, and it is only when they are seen in blossom or covered with fruit, that an orchard could be distinguished from a wood, if it were not for the regular distance between the trees, and the grass growing under them. There are some favourite sorts of apples, which have been perpetuated by grafting, at a time when it had not yet been discovered that every variety from seed has its limited period, beyond which it cannot be continued. Most of the orchards now show symptoms of old age, and gradually diminish in produce. A new generation of apples is much wanted, and will no doubt arise to take the place of the old. The true golden pippin and the cocagee are now nearly extinct; but many new varieties have been raised from seed, some of which may probably rival the old, if not surpass them. Another cause of the degeneracy of orchards is the planting of young trees on the exact spot where the old trees have decayed. Although trees do not require so frequent change as herbaceous plants or shrubs, they no doubt exhaust the soil in the immediate neighbourhood of the stem, as may be perceived by examining the roots which continually spread outwards for nourishment. As a quick hedge will not grow in the bank from which an old hedge has been grubbed up, however rich and mellow the soil may appear, so a tree will not thrive on the spot where another has stood for years, unless the soil be renovated by an abundance of lime or fresh mould. Hence new orchards planted in a good deep soil where none existed before, will produce far more abundant fruit than if the trees had been planted in old orchard grounds; and the principle of change of crop extends to trees as well as to herbs.

Devonshire was formerly no doubt well wooded, and in some places there are still fine trees, but the progress of cultivation has greatly diminished the timber, and, except in sheltered situations, trees do not thrive and acquire so great a size as they seem to have done when they sheltered one another. It has also probably been found out, that the return from a closely planted wood cut down at the end of thirty, forty, or fifty years, is greater than if the trees were allowed to increase for a century or two. Coppice wood, however, is plentiful, most of the steep sides of hills towards the banks of the rivers being covered with this growth, which adds considerably to the beauty of the valleys. The coppice wood is generally cut when twenty years old, some few poles being left till the next cutting. The best trees survive four or five cuttings; but unless they be very fine and thriving, they are usually cut down at threescore years old. The coppice wood is used for fencing, hurdles, and hop poles, and what is unfit for this purpose is sold in faggots for fuel, if near any town, or converted into charcoal. The value of a coppice cut at twenty years old, and which has been protected from the depredations of cattle, may be from 15*l.* to 20*l.* per acre. Where a coppice is well managed, and the timber preserved, the ground may be made to produce an average rent of from 15*s.* to 20*s.* per acre.

In some parts there are extensive furze brakes, which, being cut every five years for fuel, produce a very considerable return, varying according to situation from 7*l.* to 10*l.* per acre.

It is to be observed that coppice woods with a southern aspect will be two years in twenty more advanced than those facing the north. A sheltered situation will often make a still greater difference; besides, the coppice in the latter situation is considerably more valuable when it is sold. The wood grown in Devonshire is chiefly oak, but beech, ash, and elder are interspersed, according to the soil and situation. The sweet chestnut was probably a common tree formerly in sheltered situations in Devonshire, as the oldest buildings contain timbers of this tree. How it has been nearly extirpated it is difficult to say; but the climate of the vales seems peculiarly suited to this tree, so useful for its fruit as well as its timber. Since the late discovery of the quantity of sugar which can be extracted from the chestnut, this tree may again become an object of interest to those who form new plantations.

Trees planted on the summit of the hills in Devonshire seldom succeed, owing to the violence of the winds; but on the slopes of the hills they thrive well, and as they ascend, they protect each other; and thus in time the tops may be covered. Where the Scotch fir and larch have been planted in sheltered situations, they thrive well.

On a general retrospect of the agriculture of Devonshire, it must be allowed to be good, and yet it is capable of much improvement. When the springs, which are abundant, shall have been collected in drains, and the water turned into channels where it may be rendered useful to turn mills or irrigate meadows, instead of injuring the arable fields; when the meadows shall have been improved by judicious cultivation, and when a better system of convertible husbandry shall be more generally introduced; the soil and climate of Devonshire will make it one of the first counties for producing every kind of animal and vegetable food, and the cultivation will extend to thousands of acres which now are looked upon as almost absolutely barren.

DORSETSHIRE AGRICULTURE.—The climate of Dorsetshire, though mild and healthy, is not so warm as its geographical situation would lead us to expect; a circumstance owing to the nature of the soil and the bareness of its chalk hills, there being little or nothing to break the force of the winds that sweep over them. The air is keen and bracing, rather than soft and warm. In the valleys the climate resembles that of the valleys of Devonshire, and the vegetation is very similar. It appears from Domesday Book that there were vineyards at that time in several parts of this county. At present the harvest is not in general earlier than in the midland counties: and although snow seldom lies long on the ground, the land is not fit for sowing in spring sooner than in many parts of England where the winters are more severe.

A considerable portion of the soil in the south-eastern part of this county is similar to that of Bagshot Heath, and not more fertile, being a loose sand and gravel, with a portion of ferruginous loam. The whole surface of the county consists chiefly of this loose sand and gravel, clay, and chalk. The most fertile spots are those where all the three have been mixed in the valleys by the rivulets which run down the hills, carrying the soil with them. The poor sandy soil occupies that part of the county which joins Hampshire. In the centre and towards Wiltshire lies the chalk; and along the coast, over a more solid chalky rock, is a stratum of clay, which likewise covers the western part towards Devonshire, and the northern towards Somersetshire.

The following division of the soils is given in the Agricultural Report of the County, by Stevenson:—

Chalk . . .	160,759 Acres.
Sand	85,157
Loam	37,746
Gravel . . .	59,894
Miscellaneous .	13,427
Stone brash . .	29,700
Clay	117,331
Total. .	504,014 Acres.

Exclusive of rivers, towns, roads, &c.

The chalk hills to the west of Dorchester, and along the borders of the vale of Blackmore, are of considerable elevation, and contain several narrow vales and deep hollows. The soil on the most elevated parts of the chalk district is a thin loam over a rubbly chalk mixed with stones, which lies on the solid chalk. It is most advantageous to let this soil remain as sheep-walk, the pasture being fine and short, as in other downs. In the bottom of the vale of Blackmore are some extremely fertile meadows watered by the river Stour. The hills which look down upon this valley are high and bare; but the lower sides are beautifully varied with woods and fields.

The quantity of arable land throughout the county bears but a small proportion to the pasture; and greater attention is paid to the rearing of sheep and feeding of cattle than to the raising of corn. The implements of husbandry are similar to those in use in Devonshire. The wheel-ploughs are preferred in stiff and stony soils; and it is usual to put three horses before them, two abreast, and the third before the near horse; so that the furrow being turned to the right, two horses walk on the unploughed ground, and one in the furrow; they are driven by a lad. Improved ploughs have been introduced; but the majority of farmers are slow in relinquishing the instruments which they have been early accustomed to. The nine-share plough, or scarifier, has been found very useful in the light soils, and saves much time in preparing the land for the seed, as it goes over a great width and saves a ploughing.

On the larger farms the farm-houses are old buildings of stone tiles, covered with the same; in the smaller they are mostly thatched with reed. Many cottages are built with mud walls composed of road scrapings, chalk, and straw. The foundation is of stone or brick, and on this the mud wall is built in regular layers, each of which is allowed to dry and harden before another is put over it. Garden walls are frequently built of these cheap materials, their top being protected from the weather by a small roof of thatch, which extends a few inches over each side. The farms are large, many having been laid together, in prosperous times, at the desire of the richer farmers, and with the concurrence of landlords, who found that the repairs on one large set of buildings are less than on many small ones.

The rent of land varies greatly. In the poor sands it is as low as 10*s.* or 12*s.* per acre; in the richer grass lands it is from 30*s.* to 40*s.*; some water-meadows let as high as 60*s.* or more. On the whole, the average rent of grass land is about 20*s.*, of old meadow about 30*s.*, the tenant paying the tithes, which seldom exceed 5*s.* per acre.

The old method of managing arable land, which is still followed by many farmers, was to fallow every fourth year on the clays, and then take two or even three crops of corn in succession. Where clover or grasses are cultivated, they are put in with the second crop, and consequently the land is not in a clean state. The most common rotation on the rich loams in the vale of Blackmore is: summer fallow—wheat—barley with grass seeds, which continue two or three years, and are then broken up again after the hay has been made, when a kind of bastard fallow succeeds, consisting of three ploughings, and the land is tolerably prepared for wheat; but it is not clean enough to prevent the necessity of a repetition of the summer fallow every sixth year at least. There is a practice with some farmers which deserves notice, as it is a step towards the system of double crops, by which the Flemish culture is rendered so much more productive than most other. It is as follows: the clover or grass of the second year is fed off early by sheep; the land is then ploughed up and sown with rape and spring tares, which give an abundant produce in autumn, on which the sheep are folded, and the land is thus well prepared for wheat. The time of sowing is about the end of May or beginning of June. A bushel of vetches and two quarts of rape-seed are the quantities sown on an acre. The crop is fed off by Michaelmas.

On the light chalky soils turnips have been very generally introduced, although they are not yet everywhere cultivated in the best manner.

The introduction of sainfoin on the dry chalky soils has been a great advantage, as it produces a rich fodder, requires little manure, and lasts many years. In this soil the wheat is generally sown after clover which has stood one or two years, but sometimes also after turnips or rape fed off. The folding of the land saves manure, and the vicinity of sheep-downs gives an opportunity of having large folds and repeating the folding often, both before and after sowing the seed. The tread of the sheep consolidates loose soils better than the heaviest roller. The ploughing in the chalky soils is generally very shallow, because they say that the couch is thus more easily kept down; but those who plough as deep as the subsoil will permit, find that their crops are more certain, especially in dry summers;

and the couch is best eradicated by careful hand-picking after every ploughing.

Wheat is sown sometimes in the light soils as soon as August, and before the wheat crop of that year is ripe. The quantity sown is usually three bushels, and is increased as it is sown later. In the heavier loams the wheat is sown later, sometimes not much before Christmas; in that case a bushel more is required to allow for the grains that perish, or are eaten by the birds, who are then more alert after their food. The early sown wheat is thought more subject to mildew. The seed is usually steeped and limed. When it is sown very early, this precaution is frequently omitted. The average produce of wheat is from 17 to 20 bushels per acre.

Barley is here a more important crop than wheat. It is sown from the middle of March to the middle of May. The earliest sown is generally the best. The produce averages 30 bushels per acre. Oats are sown on the heavier and moister soils, at the rate of six bushels per acre. They think that the straw is better fodder where the oats are sown thick; but they perhaps forget that the heaviest grain is produced by sowing thin or drilling wide. Beans are planted or drilled in rows from eighteen to twenty-four inches distant. In the rich loams of the vale the produce is considerable—from 30 to 40 bushels per acre, and often more. Turnips are generally sown broadcast, at the rate of 3 lbs. of seed per acre; this gives an abundance of plants, which are thinned out by the hoe.

Potatoes are cultivated to a considerable extent in the rich loams about Bridport, Beaminster, Abbotsbury, &c.: they are planted in rows, or the sets are dropped in every third furrow after the plough. They are horse-hoed, and moulded up by a double mould-board plough: 24 bushels planted on an acre often produce 360. The beginning of May is the usual time of planting.

Sainfoin is sown with a spring crop: four bushels of seed are required for an acre. It is cut before the blossom is fully expanded, and made into hay, which is excellent fodder for sheep in winter. After several years, when it begins to go off, it is ploughed up, and the land sown with oats. It is often advantageous to pare and burn the land after sainfoin; but as this practice is generally forbidden in leases, however advantageous it may be occasionally, a method is adopted which equally destroys the vegetable matter without burning the soil. This is to rib the land; that is, to plough furrows with intervals, and do this again across the first ribs: the sods are thus cut in squares, and the harrows, passing over them, leave the roots in the form of matted tufts, which are burnt, and the ashes spread to enrich the ground. A regular paring and burning would be much better, both for the landlord and the tenant. Sainfoin does not produce much the first year after it is sown, and consequently many farmers sow hop-clover with it, which, being an annual, gives a produce the first year, and fills the intervals of the sainfoin, which is in perfection the second. The land which has borne sainfoin for some years is not sown again with the same crop till after an interval of ten or twelve years at least.

Hemp is cultivated to some extent in the richest soils, which contain a considerable proportion of sand, and are too light for beans. The land is prepared by ploughing it three times: first, before winter, when it is richly dunged; and next in spring, when it is well harrowed. The direction of this second ploughing is across the former furrows, whenever it can conveniently be done. The third ploughing is in May, when the ground is laid as level and smooth as possible by means of the heavy hoe or hack. Two bushels of seed are then sown evenly over it, and slightly harrowed in. A slight rolling of the ground, if it is very loose, finishes the operation. Hemp completely keeps down weeds by the shade of its leaves; and the land, if very richly manured for this crop, is in good order after it for any other which may suit it. An acre of good hemp produces 800 lbs. of fibre, a middling crop is 600 lbs., and a poor one 450 lbs. The chaff of the hemp makes an excellent manure.

Flax is likewise cultivated in the sound deep loams which have been gradually enriched by manuring the preceding crops. If the dung were not thoroughly incorporated in the soil, it would make the flax coarse and uneven. The soil must be pulverized to a considerable depth, and must also be very free from weeds. Two bushels of seed are sown on an acre. The best seed comes from Riga; the time of sowing is the middle of April. Clover seed is sometimes sown among it. It should be most carefully hand-weeded as soon as the plants can be distinguished from weeds: after this the flax and clover will keep them down. The produce is about six to eight bushels of seed, each of which gives a gallon and a half of oil, and from 600 to 900 lbs. of flax fit for spinning.

The grass lands and pastures occupy about three-fifths of the surface of the county, or above 300,000 acres, of which about 6000 are irrigated, chiefly in the sandy and chalky districts. The meadows along the vale of Blackmore are extremely rich, and produce much hay, which is used to feed the dairy cows in winter. The upland meadows are well managed, and frequently dressed with lime and dung. Many sheep which feed on the downs in summer are wintered in the vales. The pastures on the hills are not sufficiently rich to fatten oxen, but are well adapted to feed dairy cows. The Dorset butter is in good repute in London and Portsmouth for ship provision as well as domestic use: it is not so salt as the Irish, and is therefore preferred, although the Irish is richer when it is of the best quality. Dorset salt butter, when well washed, is very commonly sold in London for fresh butter. The best cow pastures will keep a cow on two acres during the whole summer: of the inferior pastures three or four acres are required for each cow. The cows are frequently let to a dairyman at the rate of 8*l.* or 10*l.* per cow for the season. This is a great convenience to a farmer who has arable land to attend to, and is thus relieved from all care but that of providing pasture for the cows, and cows for the pasture. The cows eat little else but straw in winter, and very little hay is made in proportion to the extent of grass land. The farmer finds a house for the dairyman and his family to live in, allows him to keep as many pigs and poultry as he chooses, and a mare to carry the butter to market. This mare generally produces a foal, which is part of the dairyman's profit. The bargain is from Candlemas to Candlemas. A notice to quit given by either party before All Saints' Day is considered sufficient, and the dairyman quits the premises at Candlemas. The butter is made from the cream, and the skimmed milk is made into cheese. The milk is skimmed only once in twenty-four hours. The Dorsetshire skim-milk cheese is preferred on account of streaks of blue mould which frequently run through it: these streaks are said to be produced by breaking the curd again after the cheese has been pressed, and sprinkling wheat flour over the fragments; it is then replaced in the vat and pressed again.

A few calves are annually reared to keep up the number of the cows: the calves have milk for three months, and the dairyman receives an allowance of a fourth part of the sums which he pays for a cow for each calf so reared. February is the usual time for weaning calves, because in May, when the grass is abundant, they can be turned out to advantage, and get strong before winter.

The cows kept for the dairy in the vales are chiefly of the Devonshire breed; but the pasture on the hills not being sufficiently good for them, another mixed breed is preferred there, which has longer horns, and seems to be a cross between the old long-horns and the Gloucestershire, or perhaps the short-horn. The colour is generally brindle on the sides, with a white stripe down the back and white under the belly. They are hardy, and in general good milkers on moderate pasture. Crosses with Alderney cows are occasionally met with, but chiefly in gentlemen's dairies, on account of the rich cream which they give. Dairymen prefer quantity of milk and larger cows.

The Dorset sheep are noted as a profitable breed to those who rear house-lambs for the London market. They are horned and well formed, straight in the carcass, deep in the body, and the rump is larger than in other sheep; the breast points forward, the face is thin, the horns are thin and bend rather backward, the tail is usually left long. They give much milk, and fatten their lambs better than any other breed. There is another very small breed in the Isle of Purbeck, and near Weymouth, of which the flesh is in repute with epicures: they weigh about 10 lbs. a quarter, and are generally sold by the quarter, like early lamb, and not by the pound. Some consider them as the real and original Dorsetshire breed. They resemble the small forest sheep formerly found on all the commons of the forest of Windsor, and on Bagshot-heath, the mutton of which was in equal repute as Bagshot mutton. The wool is fine, but the fleece does not weigh above one and a half or two pounds on an average. The South-Down breed is very generally found in Dorsetshire, and suits the pasture and climate better than the Leicester. The management of Dorset ewes, when they are intended for producing early lambs, is as follows:—At four years old, when the ewes have had two or three lambs, their lambs are weaned in April, and the ewes are kept on water-meadows and the richest pastures, without being ever folded, that they may be in condition to take the ram in May and June, and be forward in lamb by Michaelmas, when they are almost invariably sent to Wey-hill fair, and sold to dealers, who drive them towards London, and sell them to those who fatten early house-lamb, and who make a very considerable profit on them, if they understand how to manage the ewes to the best advantage. The Dorset ewes frequently have twin lambs, but the single are preferred for fattening. When there are twins, one of them is either killed immediately or given away. The average quantity of wool on a Dorset sheep is three and a half pounds.

DRAINING. As a certain quantity of moisture is essential to vegetation, so an excess of it is highly detrimental. In the removal of this excess consists the art of draining.

Water may render land unproductive by covering it entirely or partially, forming lakes or bogs; or there may be an excess of moisture diffused through the soil and stagnating in it, by which the fibres of the roots of all plants which are not aquatic are injured, if not destroyed.

From these different causes of infertility arise three different branches of the art of draining, which require to be separately noticed.

1. To drain land which is flooded or rendered marshy by water coming over it from a higher level, and having no adequate outlet below.

2. To drain land where springs rise to the surface, and where there are no natural channels for the water to run off.

3. To drain land which is wet from its impervious nature, and where the evaporation is not sufficient to carry off all the water supplied by snow and rain.

The first branch includes all those extensive operations where large tracts of land are reclaimed by means of embankments, canals, sluices, and mills to raise the water; or where deep cuts or tunnels are made through hills which formed a natural dam or barrier to the water. Such works are generally undertaken by associations under the sanction of the government, or by the government itself; few individuals being possessed of sufficient capital, or having the power to oblige all whose interests are affected by the draining of the land to give their consent and afford assistance. In the British dominions there is no difficulty in obtaining the sanction of the legislature to any undertaking which appears likely to be of public benefit. In every session of parliament acts are passed giving certain powers and privileges to companies or individuals, in order to enable them to put into execution extensive plans of draining. That extensive draining in the counties of Northampton, Huntingdon, Cambridge, Lincoln, Norfolk, and Suffolk, which is known by the name of the Bedford Level, was confided to the management of a chartered corporation, with considerable powers, as early as the middle of the seventeenth century; and by this means an immense extent of land has been rendered highly productive, which before was nothing but one continued marsh or fen.

In the valleys of the Jura, in the canton of Neufchatel in Switzerland, which are noted for their industry and prosperity, and where the manufacture of watches is so extensive as to supply a great part of Europe with this useful article, extensive lakes and marshes have been completely laid dry, by making a tunnel through the solid rock, and forming an outlet for the waters. All these operations require the science and experience of civil engineers, and cannot be undertaken without great means. The greater part of the lowlands in the Netherlands, especially in the province of Holland, have been reclaimed from the sea, or the rivers which flowed over them, by embanking and draining, and are only kept from floods by a constant attention to the works originally erected.

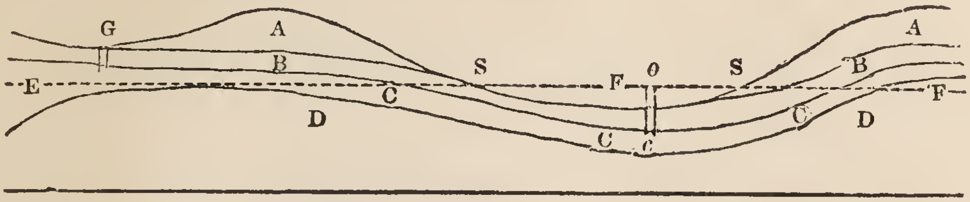
Where the land is below the level of the sea at high water, and without the smallest eminence, it requires a constant removal of the water which percolates through the banks or accumulates by rains; and this can only be effected by sluices and mills, as is the case in the fens in England. The water is collected in numerous ditches and canals, and led to the points where it can most conveniently be discharged over the banks. The mills commonly erected for this purpose are small windmills, which turn a kind of perpetual screw made of wood several feet in diameter, on a solid axle. This screw fits a semicircular trough, which lies inclined at an angle of about 30° with the horizon. The lower part dips into the water below, and by its revolution discharges the water into a reservoir above. All the friction of pumps, and the consequent wearing out of the machinery, is thus avoided. If the mills are properly constructed, they require little attendance, and work night and day whenever the wind blows.

In hilly countries it sometimes happens that the waters, which run down the slopes of the hills, collect in the bottoms where there is no outlet, and where the soil is impervious. In that case it may sometimes be laid dry by cutting a sufficient channel all round, to intercept the waters as they flow down, and to carry them over or through the lowest part of the surrounding barrier. If there are no very abundant springs in the bottom, a few ditches and ponds will suffice to dry the soil by evaporation from their surface. We shall see that this principle may be applied with great advantage in many cases where the water could not be drained out of considerable hollows if it were allowed to run into them.

When there are different levels at which the water is pent up, the draining should always be begun at the highest, because it may happen that when this is laid dry the lower may not have a great excess of water. At all events, if the water is to be raised by mechanical power, there is a saving in raising it from the highest level, instead of letting it run down to a lower, from which it has to be raised so much higher.

In draining a great extent of land it is often necessary to widen and deepen rivers and alter their course; and not unfrequently the water cannot be let off without being carried by means of tunnels under the bed of some river, the level of which is above that of the land. In more confined operations cast-iron pipes are often a cheap and easy means of effecting this. They may be bent in a curve so as not to impede the course of the river or the navigation of a canal.

The draining of land which is rendered wet by springs arising from under the soil is a branch of more general application. The principles on which the operations are carried on apply as well to a small field as to the greatest extent of land. The object is to find the readiest channels by which the superfluous water may be carried off; and for this purpose an accurate knowledge of the strata through which the springs rise is indispensable. It would be useless labour merely to let the water run into drains after it had sprung through the soil and appears at the surface, as ignorant men frequently attempt to do, and thus carry it off after it has already soaked the soil. But the origin of the springs must, if possible, be detected; and one single drain or ditch judiciously disposed may lay a great extent of land dry if it cuts off the springs before they run into the soil. Abundant springs which flow continually generally proceed from the outbreaking of some porous stratum in which the waters were confined, or through natural crevices in rocks or impervious earth. A knowledge of the geology of the country will greatly assist in tracing this, and the springs may be cut off with greater certainty. But it is not these main springs which give the greatest trouble to an experienced drainer; it is the various land-springs which are sometimes branches of the former, and often original and independent springs arising from sudden variations in the nature of the soil and subsoil. The annexed diagram, representing a section of an uneven surface of land, will explain the nature of the strata which produce springs.



Suppose A A a porous substance through which the water filtrates readily; B B a stratum of loam or clay impervious to water. The water which comes through A A will run along the surface of B B towards S S, where it will spring to the surface and form a lake or bog between S and S. Suppose another gravelly or pervious stratum under the last, as C C C, bending as here represented, and filled with water running into it from a higher level; it is evident that this stratum will be saturated with water up to the dotted line E F F, which is the level of the point in the lower rock, or impervious stratum D D, where the water can run over it. If the stratum B B has any crevices in it below the dotted line, the water will rise through these to the surface, and form springs rising from the bottom of the lake or bog: and if B B were bored through and a pipe inserted rising up to the dotted line, as *c o*, the water would rise, and stand at *o*. If there were no springs at S S, the space below the dotted line might still be filled with water rising from stratum C C C. But if the boring took place at G, the water would not rise, but, on the contrary, if there were any on the surface, it would be carried down to the porous stratum C C C, and run off. Thus in one situation boring will bring water, and in another it will take it off. This principle being well understood will greatly facilitate all drainings of springs. Wherever water springs, there must be a pervious and an impervious stratum to cause it, and the water either runs over the impervious surface or rises through the crevices in it. When the line of the springs is found, as at S S, the obvious remedy is to cut a channel with a sufficient declivity to take off the water in a direction across this line, and sunk through the porous soil at the surface into the lower impervious earth. The place for this channel is where the porous soil is the shallowest above the breaking out, so as to require the least depth of drain, but the solid stratum must be reached, or the draining will be imperfect. It is by attending to all these circumstances that Elkington acquired his celebrity in draining, and that he has been considered as the father of the system. It is however of much earlier invention, and is too obvious not to have struck any one who seriously considered the subject. In the practical application of the principle, great ingenuity and skill may be displayed, and the desired effect may be produced more or less completely, and at a greater or less expense. The advice of a scientific and practical drainer is always well worth the cost at which it may be obtained.

When there is a great variation in the soil, and it is difficult to find any main line of springs, it is best to proceed experimentally by making pits a few feet deep, or by boring in various parts where water appears, observing the level at which the water stands in these pits or bores, as well as the nature of the soil taken out. Thus it will generally be easy to ascertain whence the water arises, and how it may be let off. When there is a mound of light soil over a more impervious stratum, the springs will break out all round the edge of the mound; a drain laid round the base will take off all the water which arises from this cause, and the lower part of the land will be effectually laid dry. So likewise where there is a hollow or depression of which the bottom is clay, with sand in the upper part, a drain laid along the edge of the hollow and carried round it, will prevent the water running down into it, and forming a marsh at the bottom.

When the drains cannot be carried to a sufficient depth to take the water out of the porous stratum saturated with it, it is often useful to bore numerous holes with an auger in the bottom of the drain through the stiffer soil, and, according to the principle explained in the diagram, the water will either rise through these bores into the drains and be carried off, and the natural springs will be dried up, or it will sink down through them as at G, in the section, if it lies above. This method is often advantageous in the draining of peat mosses, which generally lie on clay or stiff loam, with a layer of gravel between the loam and the peat, the whole lying in a basin or hollow, and often on a declivity. The peat, though it retains water, is not pervious, and drains may be cut into it which will hold water. When the drains are four or five feet deep and the peat is much deeper, holes are bored down to the clay below, and the water is pressed up through these holes, by the weight of the whole body of peat, into the drains, by which it is carried off. The bottom of the drains is sometimes choked with loose sand, which flows up with the water, and they require to be cleared repeatedly; but this soon ceases after the first rush is past, and the water rises slowly and regularly. The surface of the peat being dried, dressed with lime, and consolidated with earth and gravel, soon becomes productive. If the soil, whatever be its nature, can be drained to a certain depth, it is of no consequence what water may be lodged below it. It is only when it rises so as to stagnate about the roots of plants that it is hurtful. Land may be drained so much as to be deteriorated, as experience has shown.

When a single large and deep drain will produce the desired effect, it is much better than when there are several smaller, as large drains are more easily kept open, and last longer than smaller; but this is only the case in tapping main springs, for if the water is diffused through the surrounding soil, numerous small drains are more effective: but as soon as there is a sufficient body of water collected, the smaller drains should run into larger, and these into main drains, which should all, as far as is practicable, unite into one principal outlet, by which means there will be less chance of their being choked up. When the water springs into a drain from below, it is best to fill up that part of the drain which lies above the stones or other materials which form the channel with solid earth well pressed in, and made impervious to within a few inches of the bottom of the furrows in ploughed land, or the sod in pastures; because the water running along the surface is apt to carry loose earth with it, and choke the drains. When the water comes in by the sides of the drains, loose stones or gravel, or any porous material, should be laid in them to the line where the water comes in, and a little above it, over which the earth may be rammed in tight so as to allow the horses to walk over the drain without sinking in.

It sometimes happens, that the water collected from springs, which caused marshes and bogs below, by being carried in new channels, may be usefully employed in irrigating the land which it rendered barren before; not only removing the cause of barrenness, but adding positive fertility. In this case the lower ground must have numerous drains in it, in order that the water let on to irrigate it may not stagnate upon it, but run off after it has answered its purpose.

The third branch in the art of draining is the removal of water from impervious soils which lie flat, or in hollows, where the water from rain, snow, or dews, which cannot sink into the soil on account of its impervious nature, and which cannot be carried off by evaporation, runs along the surface and stagnates in every depression. This is by far the most expensive operation, in consequence of the number of drains required to lay the surface dry, and the necessity of filling them with porous substances, through which the surface water can penetrate. It requires much skill and practice to lay out the drains so as to produce the greatest effect at the least expense. There is often a layer of light earth immediately over a substratum of clay, and after continued rains this soil becomes filled with water, like a sponge, and no healthy vegetation can take place. In this case numerous drains must be made in the subsoil, and over the draining tiles or bushes which may be laid at the bottom of the drains loose gravel or broken stones must be laid to within a foot of the surface, so that the plough shall not reach them. The water will gradually sink into these drains, and be carried off, and the loose wet soil will become firm and dry. In no case is the advantage of draining more immediately apparent.

It is very seldom that a field is absolutely level; the first thing therefore to be ascertained is the greatest inclination and its direction. For this purpose there is an instrument essential to a drainer, with which an accurately horizontal line can be ascertained, by means of a plummet or a spirit level. A sufficient fall may thus be found or artificially made in the drains to carry off the water. The next object is to arrange drains so that each shall collect as much of the water in the soil as possible. Large drains, except as main drains, are inadmissible, since it is by the surface that the water is to come in, and two small drains will collect more than a larger and deeper. The depth should be such only that the plough may not reach it, if the land is arable, or the feet of cattle tread it in, if it be in pasture. All the drains which are to collect the water should lie as nearly at right angles to the inclination of the surface as is consistent with a sufficient fall in the drains to make them run. One foot is sufficient fall for a drain 300 feet in length, provided the drains be not more than 20 feet apart. The main drains, by being laid obliquely across the fall of the ground, will help to take off a part of the surface water. It is evident that the drains can seldom be in a straight line, unless the ground be perfectly even. They should, however, never have sudden turns, but be bent gradually where the direction is changed. The flatter the surface and the stiffer the soil, the greater number of drains will be required. It is a common practice with drainers to run a main drain directly down the slope, however rapid, and to carry smaller drains into this alternately on the right and left, which they call herring-bone fashion. But this can only be approved of where the ground is nearly level, and where there is very little fall for the main drain. A considerable fall is to be avoided as much as possible; and every drain should lie obliquely to the natural run of the water. It generally happens that, besides surface water, there are also some land-springs arising from a variation in the soil; these should be carefully ascertained, and the drains should be so laid as to cut them off.

In draining clay land, where there is only a layer of a few inches of looser soil over a solid clay which the plough never stirs, the drains need not be deeper than two feet in the solid clay, nor wider than they can be made without the sides falling in. The common draining tile, which is a flat tile bent in the form of half a cylinder, and which can be made at a very cheap rate with the patent machine, is the best for extensive surface draining. In solid clay it requires no flat tile under it, it is merely an arch to carry the loose stones or earth with which the drain is filled up. Loose round stones or pebbles are the best where they can be procured; and in default of them, bushes, heath, or straw may be laid immediately over the tiles, and the most porous earth that can be got must be used to fill the drains up: the stiff clay which was dug out must be taken away or spread over the surface; for if it were put in the drain, it would defeat the object in view by preventing the water from running into it from above. In grass land the sod may be laid over the drain, after it has been filled up so as to form a slight ridge over it. This will soon sink to a level with the surface, and in the mean time serves to catch the water as it runs down. To save the expense of stone or tiles, drains are frequently made six inches wide at the bottom, a narrow channel is cut in the solid clay, two or three inches wide and six deep, leaving a shoulder on each side to support a sod which is cut so as to fit the drain, and rest on the shoulders: this sod keeps the earth from filling the channel; and the water readily finds its way through it, or between it and the sides of the drain. It is filled up as described before: such drains are made at a small expense, and will last for many years.

Where the clay is not sufficiently tenacious, the bottom of the drain is sometimes cut with a sharp angle, and a twisted rope of straw is thrust into it. This keeps the earth from falling in, and the running of the water keeps the channel open; the straw, not being exposed to the air, remains a long time without decaying. This is a common mode of draining in Norfolk, Suffolk, and Essex.

The best materials for large main drains, where they can be procured, are flat stones which readily split, and of which a square or triangular channel is formed in the bottom of the drain. If the drain is made merely as a trunk to carry off the water, it is best to fill it up with earth, well pressed in, over the channel made by the stones; but if it serves for receiving the water through the sides or from the top, fragments of stone should be thrown over it to a certain height, and the earth put over these. A very useful draining tile is used in Berkshire and other places, which requires no flat tile under it, even in loose soils, because it has a flat foot to rest on, formed of the two thick edges of the tile, which, nearly meeting when the tile is bent round, form the foot. The section of the tile is like a horse-shoe. It is well adapted for drains where the water springs upwards, and it is less apt to slip out of its place than the common tile.

In draining fields it is usual to make the outlets of the drains in the ditch which bounds them. The fewer outlets there are, the less chance there is of their being choked: they should fall into the ditch at two feet from the bottom, and a wooden trunk or one of stone should be laid so that the water may be discharged without carrying the soil from the side of the ditch. If there is water in the ditch, it should be kept below the mouth of the drain. The outlets of all drains should be repeatedly examined, to keep them clear; for wherever water remains in a drain, it will soon derange or choke it. The drains should be so arranged or turned, that the outlet shall meet the ditch at an obtuse angle towards the lower part where the water runs to. A drain brought at right angles into a ditch must necessarily soon be choked by the deposition of sand and earth at its mouth.

As the draining of wet clay soils is the only means by which they can be rendered profitable as arable land, and the expense is great, various instruments and ploughs have been contrived to diminish manual labour and expedite the work. Of these one of the simplest is the common mole-plough, which in very stiff clay makes a small hollow drain, from one foot to eighteen inches below the surface, by forcing a pointed iron cylinder horizontally through the ground. It makes a cut through the clay, and leaves a cylindrical channel, through which the water which enters by the slit is carried off. It requires great power to draw it, and can only be used when the clay is moist. In meadows it is extremely useful, and there it need not go more than a foot under the sod. Five to ten acres of grass land may easily be drained by it in a day. It is very apt, however, to be filled in dry weather by the soil falling in; and moles often do much damage to it by using it in their subterraneous workings.

But a draining plough has been invented, which, assisted by numerous labourers, greatly accelerates the operation of forming drains, by cutting them out in a regular manner, when they are immediately finished with the usual tools and filled up. It has done wonders in some of the wet stiff soils in Sussex, and is much to be recommended in all wet and heavy clays. In stony land it cannot well be used. The subsoil plough, introduced to public notice by Mr. Smith of Deanston, may be considered in some measure as a draining plough, for it loosens the subsoil, so that a few main-drains are sufficient to carry off all the superfluous moisture; and it has besides the effect of not carrying off more than what is superfluous. By means of judicious drains and the use of the subsoil plough, the stiffest and wettest land may in time become the most fertile.

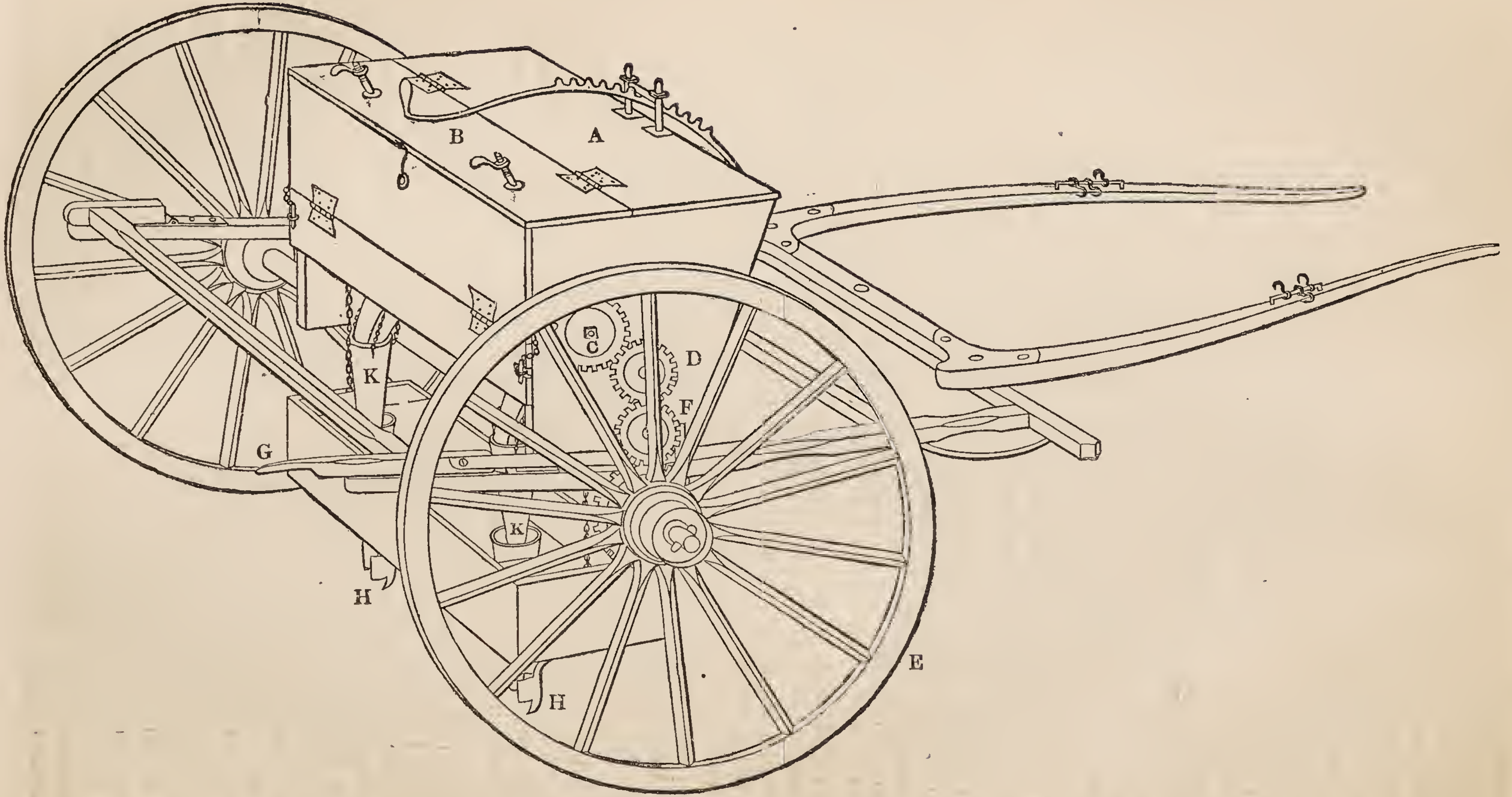
The tools used in draining are few and simple. Spades, with tapering blades of different sizes, are required to dig the drains of the proper width, and the sides at a proper angle. Hollow spades are used in very stiff clay. When the drain begins to be very narrow near the bottom, scoops are used, of different sizes, which are fixed to handles at various angles, more conveniently to clear the bottom and lay it smooth to the exact width of the tiles, if these are used; for the more firmly the tiles are kept in their places by the solid sides of the drain, the less likely they are to be moved. (For more detailed information see the works of Elkington, Stephens, Johnson, Donaldson, Young, Marshall.)

DRILLING is a mode of sowing by which the seed is deposited in regular equidistant rows, at such a depth as each kind requires for its most perfect vegetation. It has been practised by gardeners from time immemorial, and from the garden it has gradually extended to the field. In those countries where maize or Indian corn is extensively cultivated the seed is always deposited in rows; and during the growth of the plants the soil in the intervals is repeatedly hoed and stirred to a considerable depth, as is likewise the practice in vineyards. This cultivation not only keeps the land free from weeds, but by allowing the dews and the influence of the atmosphere to penetrate into the earth, greatly encourages the vegetation and growth of the plants.

It was no doubt from observing the effect produced by stirring the soil that Jethro Tull and his followers adopted the theory that finely-divided earth formed the chief food of plants; and this led to the adoption of the row culture for every species of plant, and horse-hoeing the intervals, from which the practice obtained the name of the horse-hoeing husbandry. This was at one time thought so important a discovery as to be called the New Husbandry, which was expected by its most zealous supporters entirely to supersede the old methods.

The system of Tull has been long proved to have been founded on erroneous principles. Tull himself was ruined by his experiment; and his warmest admirers, Du Hamel, Du Monceau, and De Châteauvieu, were forced to admit its fallacy, after having suffered considerable loss by adopting its practice. But the advantage of sowing the seed in rows or drills has stood the test of experience; and the drill husbandry, by combining the advantages of continued tillage with those of manure and a judicious rotation of crops, is a decided improvement on the old methods of sowing all seeds broadcast. The crops which are now most generally drilled are potatoes, turnips, beans, peas, beet-root, cole-seed, and carrots; and in general all plants which require room to spread, whether above or under the ground. The distance between the rows in these crops is generally such as to allow the use of a light plough or horse-hoe to be drawn by a horse between them without endangering the growing plants. The most common distance is twenty-seven inches, where the row culture is practised in its greatest perfection, which is in the north of England and in Scotland. The Northumberland mode of cultivating turnips, which is adopted by most scientific farmers, and seems to have decided advantages, consists in placing the manure in rows immediately under the line in which the seed is to be drilled, and keeping the intervals in a mellow and pulverized state by repeated stirring. In this mode of sowing the seeds vegetate more rapidly, and are sooner out of danger from the fly, and the crop is more certain as well as heavier. Should the turnips fail, which with every precaution will sometimes happen, the land has had the benefit of a complete fallow, and is well prepared for any other crop.

The instrument used for sowing turnips and other seeds in single rows is sometimes a small light wheel-barrow, which a man pushes before him; hence called a drill-barrow. It has a box in which the seed is put, with a slide to regulate the quantity. This is allowed to fall



Northumberland Turnip Drill.

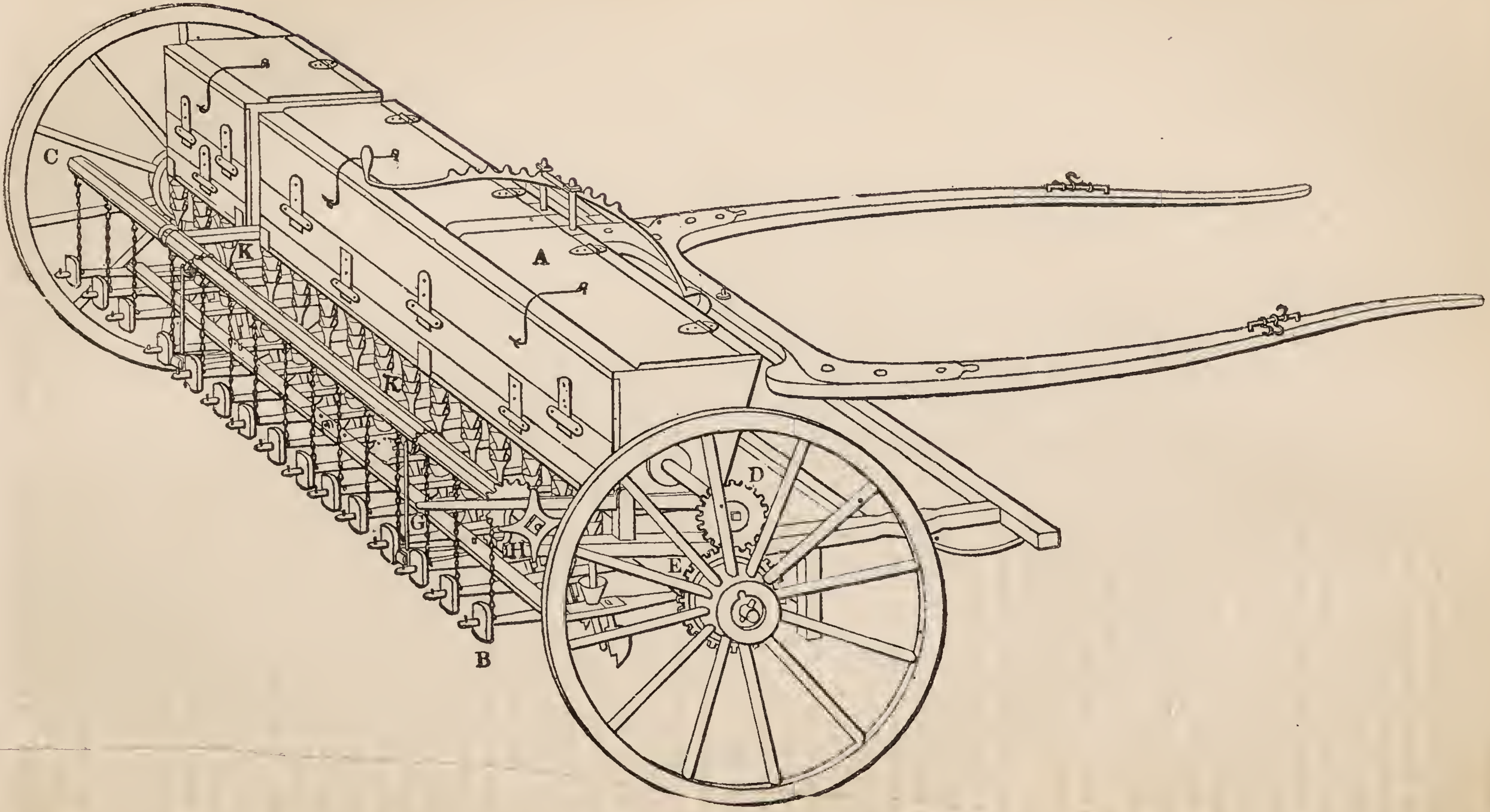
on a wooden or metal cylinder below. In the circumference of this cylinder are several cavities where the seed lodges, and is carried down into a tin funnel below; the remainder is prevented from falling through by small brushes in which the cylinder turns. The motion is communicated from the wheel which runs on the ground to the cylinder by means of a chain on two pulleys placed on the axes of the wheel and cylinder.

The improved Northumberland drill, of which a figure is annexed, is a more perfect as well as more complicated instrument. It is supported on two wheels, and drawn by a horse. It sows ground bones, ashes, rape cake, or any other dry manure, at the same time with the seed. The body of the drill consists of two boxes, A and B, divided by a partition between them, and each again divided into two by another partition at right angles to the first. In the box A is put the manure, in B the seed. Iron slides are fixed in each compartment to regulate the supply of seed or manure. In the lower part of the boxes, and just before the opening, which is regulated by the slides, are two cylinders, one for the box A and another for B. On the cylinder in A are fixed shallow cups with short stems, which dip in the bones and carry a certain quantity over the cylinder as it turns, which falling in the funnels K K is deposited in the furrows made by the coulters H H. The cylinder in the box B has projecting pieces of iron, with a small cavity in each near the end, which takes up a very small quantity of seed, and discharges it in the same manner into the two funnels K K. On the axis of the wheel E is a toothed wheel, which turns a small wheel D on the axis of the cylinder in A, and this turns another wheel C, on the axis of the cylinder in B. As these two wheels move towards each other, the two cylinders turn in contrary directions, which is a convenience in throwing the seed and the manure into the funnels K K at the same time. The wheel F may be lifted up by means of a lever G, and then the cylinders do not revolve. There are various other contrivances, which cannot well be explained without a more detailed figure of the different parts.

In some districts there is still a prejudice against the use of the drill even for turnips. In Norfolk, where the corn is usually drilled, the turnips are still very generally sown broad-cast. The cause of this appears to be, that as the cultivation of turnips was first introduced from Flanders into Norfolk, and in Flanders turnips are never drilled, because there they are generally sown as a second crop immediately after rye-harvest, they have continued the old method first introduced, and the labourers are become very skilful in setting out the plants at proper distances with the hand-hoe. In the North they were introduced at a later date, and the improved mode of sowing in rows was immediately adopted. The Norfolk farmer insists that the barley, usually sown after turnips, is better when the manure has been equally distributed than when it lies in rows, as the land is only slightly ploughed after sheep have been folded on the turnips, and the manure remains in stripes. On the whole, however, drilling in the Northumberland method seems to be the best practice, and is adopted very generally by all scientific farmers.

On light friable soils, drilling the seed is very generally adopted. There is a neatness in the appearance which recommends it to the eye; and machines have been so improved, that the seed is sown more regularly and is better covered than it could possibly be by the best broadcast sower followed by the harrows. In very stiff heavy soils, and in moist seasons, it is not so practicable to use the drill. It is sometimes impossible to get the land sufficiently dry and pulverized to allow of drilling with advantage; and when the land is wet, the tread of the horses would greatly injure it. If wet clay soils were more generally underdrained, and the subsoil plough were used to loosen them to a considerable depth, they might be rendered so dry and friable that the drill could be used at all times.

In poor sandy and gravelly soils, where bones have been found of so great advantage as a manure, drilling is the only mode by which the bones and the seed can be sown in contact with each other: an important circumstance. When the ground has been well prepared and laid



Cook's or Suffolk Patent Drill.

into stitches of a convenient width, a whole stitch may be drilled at once, with so much regularity, that an instrument with as many hoes as there are drills, and of the same width, may be drawn over the land to stir all the intervals, without danger of injuring the plants. This requires great practice and attention; but it may be considered as the perfection of the drill system. Where drilling seed is generally adopted, and the farms are not so large as to make it prudent for the occupier to purchase expensive instruments, drilling is become a separate profession. An industrious man with a small capital buys improved drills, and undertakes to drill the seed at a certain price per acre. The farmer finds horses and seed, and the driller finds the machine, and attends to the management of it himself. By constantly doing the same thing he becomes very expert; and in a neighbourhood where there are many small occupiers, a good drilling-machine, which costs from 30*l.* to 50*l.*, procures the owner a very good livelihood during the whole season of sowing; and if the instruments for hoeing were more generally used, the profession of a hoer of land might be advantageously united to that of the driller. Corn is generally drilled at the distance of eight or nine inches; and a machine which drills twelve rows will cover a stitch ten feet wide. Some prefer the rows to be nearer, but in that case the hoeing is not so easily performed with a machine, and it is done by hand. The most improved machine for drilling is Cook's patent lever drill, which sows from ten to fifteen rows at once. The description of the Northumberland turnip-drill will make the construction of Cook's drill more easily understood. In the annexed figure the box for sowing manure is not added, as it is in the Northumberland drill. The drill is supported on a frame and two wheels. The box A, which holds the seed, lets it down gradually into a lower part, in which the cylinder, which has the small cups fixed to its circumference, is turned by the wheel D. By means of the lever G this may be raised so that its teeth are freed from those of the wheel E, and the motion of the cylinder is stopped. The coulters which make the drills are each fixed to a lever, at one end of which, B, a weight is fixed to press the coulter into the ground. Each coulter has a separate lever, so that it adapts itself to all the inequalities of the soil. A chain proceeds from the end of each, and may be wound round a cylinder C by turning the handles fixed to it at H, where there is also a racket-wheel to prevent its unwinding. The intent of this is to raise all the coulters out of the ground, when the drill is not intended to act, or is moved from place to place. When the drill is used, the box A is filled with seed, and the slide in it so adjusted as to supply it regularly; the lever G, which was fixed down, is raised, and the wheel D connected with the wheel E. As the horses proceed, the cylinder turns, the cups take up the seed, and throw it into the funnels K K, which conduct it to the drill behind the coulter. A light harrow, or a bush-harrow, follows, which covers the seed. In very loose soils the roller completes the operation.

DURHAM AGRICULTURE.—The climate of the county of Durham is mild for its northern situation. The sea, which bounds it on the east, moderates the cold in winter; and the surface, being hilly without any considerable mountains, presents many sheltered valleys, the climate of which nearly resembles that of the more southern parts of the island. The soil varies in different parts; its general nature is that of a rather strong loam. In the south-eastern part of the county, northward from the mouth of the Tees, is a tract several miles in breadth, stretching along the coast towards Hartlepool, where the stiff loam is rich and productive. Next to this, to the east and north, to within a few miles of Sunderland, is a very poor thin clay, with a very hard and impervious subsoil, on which neither corn nor grass will thrive without great labour and expense. Westward of this lies a strip of excellent loam on a limestone rock, which affords the soundest pastures and the best grass, and is fit for any kind of crop. In the centre of the county there is a moist clay loam, of moderate quality, on an ochre subsoil, which gradually becomes peaty, and joins the western portion of the county towards Cumberland and Westmoreland, the whole of which last-mentioned part of the county is a poor peat or moor, chiefly covered with heath. From Barnard Castle to Darlington there is a strip bounded by the Tees on the south, which consists of a dry loam intermixed with clay. In this there are some good pastures and productive farms. In the valleys of the Tees, Skerne, Tyne, and their tributary streams, the soil is in general above the average of the district around, and consists of a good friable loam, which is cultivated at a small expense, and under good management is sufficiently profitable to the occupier.

A great part of the county lay at one time in open commons and common fields, most of which are now divided and enclosed. The moors and heaths that remain are chiefly in the poor district to the westward, and even there cultivation has spread very generally; and the wastes are profitable, in some degree, by rearing a hardy breed of sheep and cattle. The general state of cultivation throughout the county is above mediocrity; and improvements have been more readily adopted than in some of the more southern parts of the island. Fallows are found indispensable on the cold wet clays; but wherever turnips can be raised this useful root supersedes the old summer fallow. The fallows are usually dressed with lime, which is no doubt a proper application on cold clay soils; but the use of it has become so customary (being inserted as a condition in many leases), and is so erroneously considered as a substitute for dung, that it is often applied injudiciously, and with little or no advantage. In many old leases there was a clause to oblige the tenant to lay all his farm-yard manure on the old grass land, which effectually prevented the improvement of the arable part of the farm.

Lime being thought a sufficient manure for the arable land, the consequence was the gradual deterioration of the latter, without a proportional improvement of the meadows. But a better system has been introduced. The lime is now usually put on when old grass land is broken up or converted; and where arable land has been repeatedly limed, good rich dung is found to be more profitably employed, when ploughed in, than when used as a top-dressing for grass. There is little or no marl found in the county.

The rotation usually adopted on the better soils includes two or three years of grass, and begins invariably with turnips, well manured, and drilled according to the Northumberland method. [DRILLING.] The convertible husbandry described in the account of the agriculture of BERWICKSHIRE is very generally adopted by the best farmers, and found most profitable in the end.

The occupations are not, in general, very large. There are some few extensive farms; but the average size is from 150 to 200 acres of enclosed land. There are many small occupations of 40 and 50 acres, which is as small a farm as can be cultivated with profit, unless the spade husbandry be adopted, which is not yet done to any extent in this county.

The implements of husbandry have nothing peculiar in them. The ploughs are chiefly of the improved kind: the old heavy clumsy ploughs are scarcely ever seen in use. Horses are almost exclusively used for agricultural purposes; and an ox-team is a rarity. It is found that oxen are more profitable when fatted at a young age for the butcher, than when used to work on the farm. Thrashing-mills are common, and there is not in the northern counties that foolish prejudice of the ignorant labourers, which made many of them rise to destroy thrashing-machines in more southern counties, and which still prevents the use of them where they would be highly advantageous, not only to the farmer, but also to the labourer, who would then not so often suffer the pains of rheumatism in his old age, the consequence of the continued exertions of his limbs on the thrashing-floor.

Corn is sown by the drilling-machine wherever the soil is sufficiently friable, or is made so by good tillage. In heavy soils the broadcast method of sowing still prevails.

There are many rich upland meadows and permanent pastures, where cattle and horses are bred to great advantage, and where oxen and sheep are fattened by grazing; but there are very few water-meadows, although there are many situations where they might very easily be established. The quantity of hay on the upland meadows is on an average 1½ ton per acre: 2 tons is considered a heavy crop. They have a method of drawing together the cocks of hay, when it is fit to be stacked, which saves the loading on waggons. This is done by means of a wooden frame drawn by two horses. This frame is held in an oblique position, and partly drawn under the cock so as to scrape the surface and force the hay upwards. It slides on the mown grass, and is drawn to the stack, which is made to contain ten or twenty tons. It is but slightly thatched when completed: several small stacks used formerly to be placed in various parts of a large piece of grass land, and in winter the cattle were left in the fields, and pulled the hay out of the stacks all round, sheltering themselves near them. This was a great waste of hay, and a very unequal distribution of the manure. A better system prevails now, and the cattle are kept in yards, where the dung is more carefully collected and increased with straw, and where the hay is brought as it is cut out of the stack, by which means none of it is wasted. The best meadows are mown every year, and manured every third or fourth year. Some prefer mowing and feeding alternately, which keeps the land in good heart and the herbage fine. Horses are generally considered as detrimental to the pasture; their manure is too hot, and brings coarse weeds forward. Sheep greatly improve the pastures, and are in consequence preferred.

When grass land is ploughed up and converted into arable, the practice of paring and burning the surface is very generally adopted. The first crop after this is generally turnips, which seldom fail when sown with fresh-burnt ashes. The next crop is wheat or oats; after which, if the soil is very stiff, a clean fallow succeeds; if it is lighter, another crop of turnips, which brings the land in a proper state for a regular course. This appears to be a most excellent practice, and far superior to the old Devonshire plan of taking as many crops of corn after burning the sod, as can be made to grow. When the surface is not burnt, the usual course is to plough the grass up in autumn, and let it lie all the winter to rot: it is then ploughed again in spring, and sown with oats: the next year it is fallowed, and prepared for the course which is thought to suit the nature of the soil.

This county is not remarkable for its gardens or orchards. The soil and climate are not very favourable to fruit-trees, and, except in the gardens of gentlemen of fortune, they are not much attended to.

There are some good oak-woods, and many new plantations, where the tenure is freehold. Where it is copyhold, under the Bishop of Durham, one-third of the timber, above what is required for repairs of buildings, belongs to the bishop, which is an insurmountable obstacle to planting—and where the land is held on lease, renewable every seven years on an uncertain fine, every improvement increases the sum demanded. Many of these lands have been enfranchised by Act of Parliament, with the consent of the bishop; but many still remain on the old tenure.

The cattle bred in the county of Durham are in great repute all over England and Scotland, and a great number are annually purchased at the different fairs in this county, and driven northward and southward. The Teeswater or Holderness breed is the finest of the shorthorns. The cows are remarkable for the quantity of milk which they give, as well as their aptitude to fatten. The oxen are considered as the most profitable breed for stall-feeding, as they become fit for the butcher at an earlier age than most other breeds. The milkmen near London and other large towns scarcely ever have any but Durham cows, some of which will give twenty-five to thirty quarts of milk per day for several months. When they become dry, they increase so fast in flesh and fat, that they are soon very advantageously disposed of. They are of a quiet disposition, and bear to be kept continually tied up in stalls; and they accommodate themselves readily to every kind of food, whether it be grass or hay, roots, grains, or distillers' wash. This breed came originally from Holland, as is asserted, and this appears probable: but it has been much improved by a careful selection of bulls to breed with. This may be attributed to a few skilful and zealous breeders. The famous Durham ox at ten years old weighed alive 34 cwt. He was slaughtered at eleven years old, in consequence of an accident by which he dislocated his hip-joint; and although wasted by being eight weeks in great pain, his carcass produced 165 stones 12 lbs. net meat (14 lbs. to the stone), and above 21 stones of hide and tallow. In June, 1801, when he was five years old, the proprietor refused 2000*l.* for him, and made a great deal of money by showing him all over the kingdom for six years. (Bailey's *Agricultural View of the County of Durham.*)

The milk of the Holderness cows, although abundant, is not so rich in cream as that of some of the smaller breeds. But quantity and quality are seldom united, and the dairymen who make butter or cheese prefer cows of different breeds, which give rich milk, but do not get fat so readily.

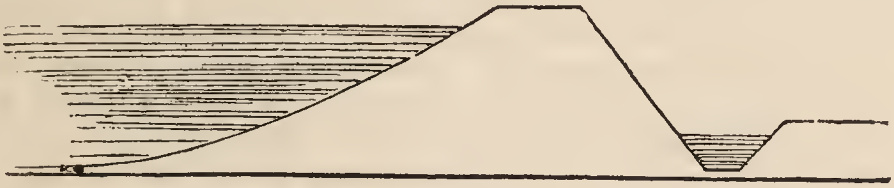
The horses bred in this county are of a superior description, both for draught and for the saddle. The Cleveland bays are preferred for their vigour and activity. For farming work and drawing loads of coal or lime few horses surpass them. A good horse will draw in a cart nearly a ton of coals from the distance of thirty, and even thirty-five miles, over hilly and rough roads; going and returning in the twenty-four hours, without any considerable rest, and often without being out of harness the whole time; he will do this three times in the week, and do light jobs the other days. Horses can take longer journeys in hilly countries than in flat, without being distressed, as is well known. Hunters of superior power are produced by crossing strong active mares with blood horses which have great bone as well as spirit; or better, by having a breed produced by selected half-bred stallions and mares. A good hunter is a more valuable horse for the breeder than a race-horse, which may prove a prize hereafter, but seldom remunerates the breeder for his risk and trouble.

The young stock are kept in rich and extensive pastures, where they have plenty of food and good water. The dry pastures on the limestone rock are peculiarly adapted to rear horses, the sound soil being very advantageous to the proper hardness of the hoof.

There was once a very large breed of sheep in the south-eastern part of the county, which bore heavy fleeces, and when killed often weighed from 50 lbs. to 60 lbs. the quarter. But the improved Leicester breed has nearly superseded them, as being more profitable, and fattening at an earlier age. There is a small and hardy species of sheep on the heaths and moors, which is similar to those found in other counties on the same description of land. They cost little to maintain, and produce little; but when fatted at four or five years old, the flesh is rich and delicate.

EMBANKMENT. It is often necessary to raise mounds or dykes along the course of rivers to keep them within their channels, and prevent their flooding the lands which lie near them, when the waters rise above their usual level. Those alluvial lands which lie near the mouths of rivers and are below the line of high water cannot be cultivated to advantage unless they are secured from inundation by proper embankments; and as these alluvial deposits are generally very fertile, it amply repays the expense of constructing dykes and keeping them in repair. The whole of the provinces of Holland and Zeeland, and several other districts in the Low Countries, could not be inhabited if the sea were not kept out by strong embankments; and the destruction of a dyke frequently desolates great tracts of country. The art of constructing dykes and of keeping them in repair is therefore one of the greatest importance to the proprietors of low lands situated as above described.

The first thing to be attended to in forming embankments is to enable them to resist the pressure of the highest floods which are likely to occur, and to prevent the effect of the waves and currents in washing them away. When it is the simple pressure of a column of water which is to be withstood, a simple earthen bank made of the soil immediately at hand, provided it be not of a porous nature, is sufficient. Its form should be a very broad base with sloping sides and with a flat top, which may serve as a path or even a carriage-road, if the bank be of considerable dimensions. The side towards the water should slope more gradually than towards the land, where it may form an angle of 45° with the horizon. A ditch is usually dug along the inside of the bank, and sometimes on both sides, when the dyke is at some distance from the usual channel of the water, and is only a precaution against unusual floods. The inner ditch collects the water which is produced by rains or may find its way by filtration through the bank or the soil.



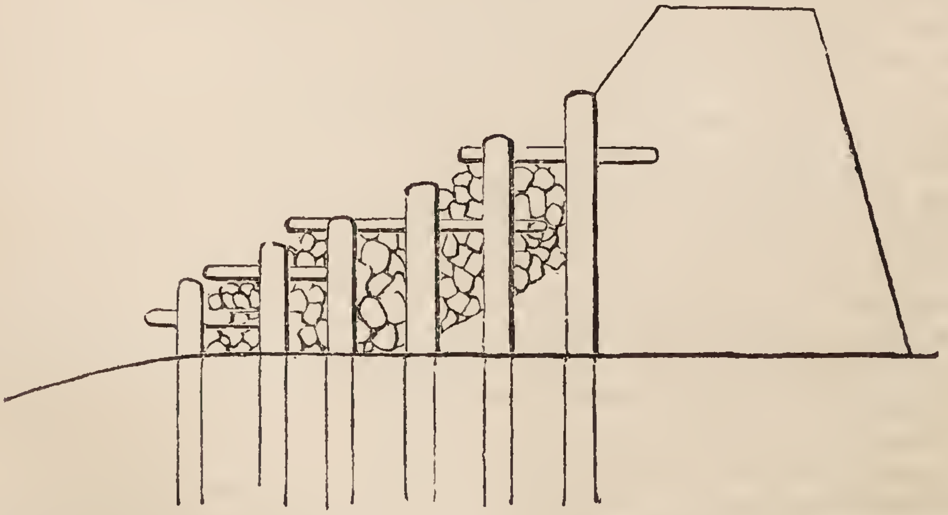
To raise these simple dykes nothing is requisite but to carry the earth from below, and consolidate it by treading it in a moist state, that no interstices be left. Such are the dykes along the slow-running rivers and canals in Holland. But where a considerable river winds through an extensive plain, and is apt to change its bed by the wearing away of the banks in some places and the deposition of mud in others, more skill and more expensive works are required to keep it within its banks and to prevent the effects of a rapid current in destroying them. In this case strong piles are driven deep into the ground, and, instead of earthen dykes, stone walls are opposed to the force of the water.

The embanking of a considerable river often requires the course of the stream to be changed, and instead of the winding course which rivers naturally take through plains, straight channels are artificially made for them. At first sight it would seem that a straight channel is the natural course of a stream; but this is far from being the case. A straight course can never be maintained without artificial means; water never flows in straight lines, but always in curves. The slightest inequality in the bottom or sides partially obstructs its course, and produces a circular motion in the water; and this, acting on soft banks, soon hollows them out, which, increasing the eddies, accelerates the change in the current. When a river is turned into a new channel, the banks must be strengthened with piles or masonry, and the foundations of the works must be laid below the gravel or stones which may have accumulated, that they may not be undermined by the percolation of the water.

When the dykes are only intended to check the waters at the time when they flow over their natural banks, it is best to raise them at some distance from the river on each side, and parallel to its course; because, in sudden floods, the water, having a greater space to flow through, will not rise so high, and will sooner recede. The natural banks must be carefully attended to in this case, that they may remain nearly the same, without being subjected to that continual change which we have noticed before. Those who have long attended to these changes and their immediate causes will find no difficulty in checking them in the outset by very easy and simple means. Whenever a bank begins to be undermined, a few piles driven in judiciously, and some stones thrown into the river above the place where its banks begin to wear away, will cause a change in the current, and throw it over to the opposite side. Indeed, if this is done injudiciously, the banks opposite will begin to wear away; but by continued attention and prevention, rather than correction, any river having a moderate current may be kept within its proper bed.

It sometimes happens that rivers near their mouths form shallow æstuaries, and occupy much ground which might be usefully employed. In this case an entirely new outlet may sometimes be made, through which the river may at once discharge itself into the sea; and the whole course will probably be soon filled up by the deposition of soil and mud brought in by the tides; for it is the current which clears the channel, and when this is taken away the channel soon fills up. In the course of a short time the old mouth of the river will be so filled up as scarcely to admit the tide; and an embankment across it may lay a large fertile tract of land quite dry.

Where embankments are made against the sea, greater skill is required to resist the force of the waves. If there are materials at hand to lay a bank of stones imbedded in clay, with a broad base, and the sides sloping very gradually upwards, a very safe barrier may be opposed to the waters. It is not the direct impulse which is the most destructive—waves striking against a sloping surface lose their force and rise over it; but it is in returning that they draw the materials with them and scoop out the foundations. If the stones are well joined together, the retiring wave will have no effect in loosening them; but if any one of them can be singly removed from its place, they will soon disappear one after another, till a breach is made; after which a single storm may destroy the whole embankment. There are many parts of the coast of England where whole estates would soon be swept away, if it were not for continual attention to the embankments. Near the mouth of the Thames, in particular, on the north side, and all along the coast of Essex, the sea is only kept out by incessant attention to the sea-walls. In various places the ingenuity of scientific men has been exercised to invent various modes of resisting the force of the sea. In some exposed points piers of solid oak have been made, which oppose a smooth surface obliquely to the force of the waves; in others, rows of piles have been driven in, forming lines at right or oblique angles to the line of the shore, in order to intercept the waves, and break their force before they reach the bank. In a place where the rounded stones called shingles were usually thrown up by the waves, and the bottom was a strong clay, their retreat has been intercepted by rows of strong piles driven in a line along and parallel to the shore, and covered with boards nailed to them on the land side. By this means the sea has been made to provide the materials of the embankment, and to lay them down. In one night the shingles have been thrown over the piles; and being retained by the boarding, have formed a perfect wall. A second row of piles between the first and the sea, and a third if required, forms a sea-wall which might defy any storms. We mention this as an example of the advantage which may be taken of particular circumstances by which a great expense may sometimes be saved. In other situations, where the shingle is not thrown up, and the wall is not so immediately exposed to the action of the waves, an excellent facing of the wall is

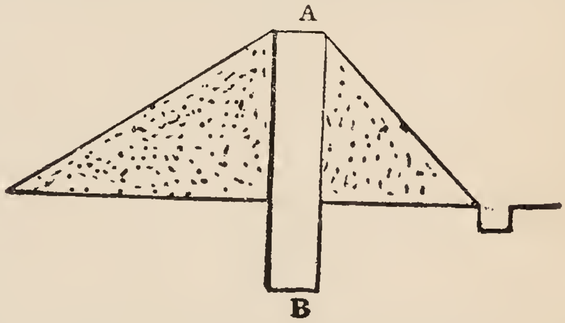


made by several rows of piles from five to fifteen feet long, driven along the side of the earthen bank in the form of steps rising above each other. These piles are driven very close together, and the distance between the rows is about two feet. This interval is filled with stones, and bushes are pinned down over them by means of wooden pins driven horizontally through holes made in the piles. This contrivance effectually prevents the washing away of the bank.

Where the land lies very flat for a considerable distance from the shore, it is of advantage to have two complete banks, one within the other; so that if the outer bank is broken through, the second will keep back the waters, until the first can be repaired. The ground between the two lines of banks is usually left in pasture. In this case the damage done by an inundation of salt-water will not be so great as if the land were arable; and unless it remain flooded for a considerable time, the herbage suffers little, if anything, from it.

The water which accumulates within the banks and is collected in the internal ditch and those which divide the marshes must be let off occasionally by means of channels and sluices at the time when the tide is out, and the water outside the bank is lower than that which is within it. In small embankments a wooden trunk or pipe may be laid through the bank, with a valve opening outwards, by which means the superfluous water may flow out, and none flow back. It is useful to carry this trunk a considerable way outside the bank, if it empties itself immediately into the sea, in order that it may not be choked up with sand or shingles. Cast-iron pipes are conveniently used for this purpose, and they may be carried out so far as to empty themselves below low-water mark. But when the embankment is very extensive, and there are streams flowing through the part which is embanked, larger flood-gates and more extensive works are necessary. These being opened and shut as occasion may require, serve to keep the channel clear, by producing occasionally a considerable rush of water to carry away mud and sand which would otherwise have accumulated at the mouth of it. When the level of the land which is embanked is below the usual level of the waters which are without, the water is raised by means of engines over the banks, as is the case in the fens. [DRAINING.]

In the forming of the banks, where the soil may not be quite impervious to water, it is useful to begin by digging a ditch in the line of the intended bank, of such a depth as to reach an impervious subsoil. This ditch is to be filled up with clay or tempered earth, and as the bank is raised, the middle of the bank should be composed of the same materials, which will thus form a vertical wall A B up to the top; and the more porous earth being heaped up against the sides of this wall will form the slopes of the bank; thus the whole will be perfectly impenetrable to the water. The clay should be well trod in with the feet in a moist state, and no pieces of wood or even straw should be in it; for a straw may be the cause of the water finding a passage through a bank, and this passage gradually widening will soon produce a hole, which may in the end cause the destruction of the bank. Moles and worms are great enemies to dykes. In Holland the storks are held in great veneration, and are never molested, because they are supposed to destroy a species of worm which often does great mischief to the dykes by perforating them.



ESSEX AGRICULTURE.—The climate of Essex is favourable to vegetation; the sea and the numerous æstuaries which bound it on the south and east soften the rigour of winter, and keep up a certain degree of moisture in summer. The same cause, however, produces cold fogs and exhalations in spring and autumn, which are very prejudicial to the health of those who are not inured to the climate. In consequence of this, the most fertile portions of the county, which lie along the Thames and the sea-coast towards the Colne river, and which are usually called the hundreds of Essex, contain few seats of men of fortune; and notwithstanding the richness of the soil, and the great advantage of the marshes for feeding cattle, few men from other counties venture to take farms in this part of Essex. This reproach to the climate of the hundreds of Essex is rapidly diminishing, since the marshes have been better drained, and the woods, which prevented the free circulation of the air and the dispersion of fogs, have been gradually cut down, and the land brought into cultivation. The soil all along the coast, and ten or twelve miles inland, is of a very excellent quality, being a friable loam of greater or less tenacity in different parts, but peculiarly adapted to the cultivation of wheat, beans, and oats. The Isle of Mersey, which lies at the mouth of the Colne river, has been long noted for the fertility of its soil, which is a fine alluvial loam composed of the various earths deposited from the river and the sea, like the warp lands along the Humber, or the polders in the Netherlands. The whole island is protected by a sea-wall, and produces every kind of grain which is usually cultivated; wheat, barley, oats, beans, and rape-seed are the principal produce. Sir Humphry Davy found that the soil taken from Mersey Island and dried recovered its moisture from the atmosphere in less time than any other on which the experiment was tried; and this gives perhaps a better measure of fertility than any chemical analysis of its constituent parts. The best soils of Essex lie low, and require to be protected from the sea by embankments. Many marshes which formerly produced nothing but herbage, and were subject to inundations, are now converted into arable fields; and a great tract of land all along the coast, which used to be covered by the sea at high tides, is now laid dry by proper deep and broad ditches, here called fleets, and protected by high and well-constructed sea-walls, the repairs of which are a great expense to the proprietors. In some of these marshes the want of fresh water in summer was often felt severely; but lately recourse has been had to boring, which has been attended with great success, especially in the marshes at St. Osyth, where the finest springs of water have been found, which flow over the surface, and keep ample reservoirs continually full. The depth at which the water was found did not exceed fifty feet. This discovery greatly increases the value of these marshes in dry summers, such as that of 1836. The soil in the uplands along the coast consists chiefly of good loams varying in tenacity from a strong clay to a light gravel; most of it is of such a nature as to bear both turnips and beans. The stiffest soils, as well as the lightest, which form the two extremes, are more inland. The whole county has an undulating surface, which is very pleasing when fields and woods are interspersed, as is very generally the case in this county. The only level tract is that along the Thames, which extends to its mouth and along part of the south-eastern coast. The remainder consists of gentle elevations just sufficient to give a great variety of soil and aspect. The clay soils, on the whole, prevail in most parts of the county, and from this circumstance arises the modes of cultivation and the rotations of crops which are most commonly adopted. There are very few such light soils in Essex as there are in Norfolk and in Lincolnshire, and, except on the borders of Hertfordshire and Cambridgeshire, chalk and marl are rare.

The cold wet clays have given rise to a mode of tillage which is minutely described by Arthur Young in his View of the Agriculture of this county, and held out as a pattern for the cultivation of cold wet clays. It consists of repeated ploughings in spring and summer, and exposure to frost in winter; two things, no doubt, highly beneficial to stiff land. But since the introduction of extensive under-draining and high manuring, much of the labour of the horses in ploughing and harrowing has been saved. The peculiarity of the Essex method on stiff clays was, to work the fallows two winters for barley, during which period the land was ploughed in all directions eight or nine times, and even more, until it was sufficiently pulverized. The rotation was —fallow; barley; fallow; wheat; beans: that is, two fallows in five years. The beans were frequently omitted: so that the land was alternately cropped and fallowed. No stock was kept on the farm, but a few cows for the use of the farmer, and the horses required to plough the ground; and the soil not being favourable for artificial grass, very little manure could be made except upon those farms which have marshes attached to them, which is not generally the case where the soil is the stiffest. There was consequently no sufficient manure for the land, and fallows were unavoidable to keep the soil in a moderate state of fertility. From sixteen to twenty bushels of wheat per acre, and from twenty-four to thirty of barley, was a common average produce on very good clays, which, with underdraining and proper manuring, now produce thirty-two of wheat and forty-eight of barley. The fallows at the same time are now removed to every fifth or sixth year.

The present mode of ploughing in Essex is similar to that of Norfolk and Suffolk; the ploughs most commonly in use are Suffolk wheel-ploughs, or swing-ploughs without wheels. The great manufactory of these instruments is that of Messrs. Ransom, at Ipswich, which chiefly supplies the three eastern counties. In good loams, not too stiff, two horses are driven abreast with reins, whether the plough has wheels or not. In the very heavy wet clays three horses are used, who walk one before the other in the furrow. The object is that they may tread the land less; but some very judicious agriculturists maintain that three horses treading the bottom of the furrow render it quite impervious to water, and do more harm than if they had walked abreast over the land already ploughed, where they would only have trod in small cavities. This is rather a new mode of viewing the subject, but it is worth considering and making trials to ascertain the real effect.

After harvest the stubble is generally ploughed in, and before winter the field is laid in narrow ridges, which are formed by two turns of the plough, and sometimes by four turns, or two bouts, as they are called. The ploughmen are expert in this, and lay the ridges very regularly, sometimes diagonally across the field, which has a good effect in dividing the soil more completely. In this form a greater surface is exposed to the frost and air, and in spring it is mellow and crumbling, where in autumn it rose in an unbroken furrow. If a fallow is intended to clean the land, it is ploughed at intervals, and the roots of weeds gathered and burnt; if it is not very clear of these by wheat-sowing time, it is put in ridges again till the next spring, by which time it is quite pulverized, and fit to be manured for barley and clover. If wheat is sown in autumn, the manure is put on before the last ploughing.

The most common rotation on the stiffest clays, which will not bear turnips, is now—1, fallow; 2, wheat or barley; 3, clover; 4, oats or wheat; 5, beans; and where manure is abundant, a second crop of wheat is taken in the sixth year, before the course begins again. On the rich soils, which bear turnips, the usual rotation is turnips, barley, clover, wheat, beans, oats, or wheat. The manure is put on for the turnips and the beans: peas and tares are taken on part of the land, which otherwise would have had clover, and on that where the clover has failed. The mole plough has been used with good effect in many stiff soils, but the treading of the horses when the ground is soft, the only time when the mole plough can be used with effect, does a great deal of harm on such land, so that this instrument is not so generally used as it might be. The method of draining introduced of late is so superior in its effects to the mole plough, that this instrument will soon be laid aside, except in old pastures, where it may sometimes save the expense of draining. The subsoil plough is not yet generally introduced, but will, no doubt, soon be found an admirable instrument. The feeding of oxen in winter is now extensively practised by all good farmers in Essex, whether of strong or light loams. In sandy and gravelly soils sheep may be more profitable; but where turnips, especially the Swedish, or mangel-wurzel, can be raised, on heavy soils, the only practical plan is to draw them, and give them to the cattle in yards or stalls, together with straw and oil-cake. When the soil will not allow the carts to go over the fields where the turnips are without doing harm in winter, asses with paniers are used to bring the turnips to a cart on the hard road, or at once to the yard, if it is near at hand. Asses and boys may be employed in this manner with advantage in many situations, and the expense will not exceed that of horses and carts, although they bring but a small load at a time.

In those farms which have marshes attached to them a great number of cattle is constantly kept, and all the straw is converted into manure, by which the arable land is kept in a high state of fertility. Along the Thames the salt marshes are extensive, and are profitable from the number of horses which are sent to feed there from London, after they have been over-worked and require rest, or when they have met with some accident. Where there is not a sufficient number of horses taken in to stock the marshes, oxen and sheep are brought to complete the number, but the profit on these is seldom equal to that on horses agisted.

Besides the common crops usually cultivated, a considerable quantity of cole or rape-seed is raised on the richer alluvial soils of the hundreds. It is a profitable crop, owing to the abundant supply of manure brought from London by the Thames. In other situations it has been found to deteriorate the succeeding crops too much, and the cultivation has been abandoned. Flax is not cultivated anywhere in the county, at least to any extent, and very little hemp is sown. A few hops are raised in the western part of the county, towards Cambridgeshire. The cultivation of this plant is spreading rapidly, and every year some new hop-gardens are formed. The extent of hop ground is, however, inconsiderable, when compared with that in the hop-growing counties of Kent, Surrey, Hertfordshire, &c. The cultivation of caraway, coriander, and teasels, which is peculiar to this county, is described under CARAWAYS.

In that part of Essex which lies within a few miles of London the cultivation of the soil partakes more of the garden culture. Vegetables, especially cabbages, are raised in great quantities, and very extensive fields are almost entirely devoted to the raising of potatoes. The ground is ploughed, and very highly manured with stable-dung from London. The potatoes are usually set by hand, and moulded up with the plough. They are taken up with the common three-pronged fork, and wheat is immediately sown after the principal crop is taken up. Those which are of an early kind, and taken up in June or July, are followed by cabbages. Mangel-wurzel for the London cowmen is also raised in considerable quantities. The meadows within fifteen miles of London regularly supply the Whitechapel market with hay, and every cart brings back a load of dung.

The cows and horses in Essex are chiefly reared in Suffolk, and Scotland supplies the oxen to fatten. There are a few considerable dairies about Epsom; but in general the number of cows kept on a farm is not considerable. Many calves are fatted, which are killed in the county, or go to Romford to be sold to London butchers.

Sheep are now kept in greater flocks by the Essex farmers than they used to be, and with considerable advantage. By means of draining, the land has been made capable of being folded over even in winter. It is not a sheep-breeding county, although many fine lambs are reared; but they are generally bought from the breeders in Wiltshire or Sussex in autumn, and sold fat to the butcher in the succeeding spring. The South-down breed is preferred in general; but there are also many improved Leicesters, and lately the Norfolk sheep have come into favour with some farmers, who think them hardy and profitable, and whose fences are in such a state as to repress their rambling propensities. There is no peculiar breed of horses. The Suffolk punches seem to be in general use for farm work, and it is scarcely possible to find a breed better adapted for every kind of work. When crossed with a half-bred horse of some substance and action, a

Suffolk mare produces admirable carriage horses. In the marshes a good many horses are bred of various kinds, chiefly for draught. Essex has been long noted for a superior breed of pigs, which has been produced and improved by crosses with foreign breeds, chiefly the Neapolitan, which has very little hair, and the Chinese. The common Essex pigs have long ears standing upright, and thin in their texture. The best breeds are quite black, and have *wattles*, which are small appendages of skin, like a long teat, hanging from the neck under the jaws. The most common Essex pigs, which are brought in great quantities to Smithfield market, are black and white, the head and rump being generally black, and the back and belly white. They fatten early, and make excellent small pork when fed on the refuse of the dairy. Lord Western's breed is in great repute, not only in Essex, but all over England.

FALLOW is a portion of land in which no seed is sown for a whole year, in order that the soil may be left exposed to the influence of the atmosphere, the weeds destroyed by repeated ploughings and harrowings, and the fertility improved at a less expense of manure than it would be if a crop had been raised upon it.

The practice of fallowing land is as old as the Roman Empire. It appears that wherever the Romans extended their conquests and planted colonies, they introduced this mode of restoring land to a certain degree of fertility when exhausted by bearing grain. The principle on which it was recommended was, however, erroneous. It was thought that the land grew tired of raising vegetable produce and required rest, and hence this rest was often all that constituted the fallow; the tillage, which alone is the improving part of the process, being almost entirely neglected. Where land was abundant and the population thin, it was no great loss to allow a considerable portion of the soil to remain unproductive; and it was cheaper to let land lie fallow during the course of a whole year, which gave ample leisure for every operation, than to accelerate the tillage and increase the manure put upon it. But when land becomes of greater value with the increase of population, it is a serious loss if a great portion of the soil be thus left in an unproductive state. Accordingly the attention of agriculturists has been turned to lessen the necessity of fallows, and to substitute some other means of restoring fertility. It is acknowledged by all experienced farmers that manure alone is not sufficient for this purpose. The ground must be tilled and noxious weeds destroyed; and the only efficacious mode of doing so is to stir the ground at the time when their seeds have vegetated, their roots have made shoots, and before any new seed can ripen. But this is exactly the time when corn is usually growing, and when the land cannot be stirred to expose it to the heat of the sun and to dry the roots which are turned up. The only apparent remedy is therefore not to sow it during one summer, and on this principle lands are usually fallowed. The manner in which this is done has been noticed before [ARABLE LAND]; and the common process is so simple, that, provided the purpose of fallowing be kept in view, the operations require only a little attention to time and weather to be performed aright.

There is no difference of opinion respecting the manner of extirpating weeds by repeated ploughing and harrowing, but there is with respect to the influence of the heat of the sun upon the land. Some men are of opinion that light is the great purifier of the soil; that it decomposes certain noxious particles, which are the result of the formation of the seed, and which have been termed the excrements of plants. Physiologists agree that the roots draw the nutritive juices out of the soil, that they undergo a chemical change in the plant, and that there is an exudation also from the roots, which may be looked upon as the residuum of the natural process. De Candolle, Raspail, and other eminent physiologists have placed this point beyond controversy; but no one has yet been able to collect these matters so as to analyze and compare them; and the reasonings on the subject have been merely conjectural. In particular soils and situations a scorching sun has a pernicious effect on the soil which is exposed to his rays; and where it is shaded by a crop which covers it completely, it seems to have acquired fertility, which the exposed surface has not. But this is not sufficient to establish a general rule. Some soils which are of a wet nature are greatly improved by being as it were baked in a hot sun. Not only are the weeds destroyed by the abstraction of moisture, but the soil thus becomes lighter and more friable. On sandy soils the reverse is the case, and on intermediate loams the effect will be more or less advantageous as they approach nearer to the clay or to the sand. In light sandy soils, then, it is probable that the only advantage of a naked fallow is to kill weeds, especially the couch-grass (*triticum repens*), which is apt to infest light soils: and that the exposure to the sun in hot weather is not only no advantage, but probably detrimental. If, then, any means can be devised of clearing light lands from weeds without leaving them fallow for a whole summer, a great advantage will be obtained. This has been effected completely by the cultivation of turnips and clover, which was first practised in the light soils of Flanders, and afterwards introduced into the similar soils of Norfolk, from whence it has spread all over Great Britain, and is beginning to be adopted more generally in Ireland. The advantage of the turnip culture is so great in light lands, that it has gradually been extended through the different gradations of loams, till it has reached even the colder and stiffer clays, on which it would at one time have been thought absurd to attempt to raise this root. But this has been attended with an important benefit. It has made the cultivators of heavy soils turn their attention to the drying of their lands, by draining and deep tillage, in order to make them capable of bearing turnips; and although the extended culture of this useful root is not what we should recommend for cold wet clays, we highly approve of all improvements which will make such lands capable of bearing good crops of turnips. Unless the turnips can be consumed by sheep on the spot, or by cattle near at hand, without injuring the land in taking off the turnips and carting on the manure, there will be no great advantage in a crop of turnips; and some other substitute must be found for the occasional fallow before it can be altogether abandoned. On light lands the preparation for the turnips, the abundant manuring, and subsequent hoeing, are as effectual in cleaning the land and bringing it into a fertile state as any complete fallow could ever be; and the clover smothers and destroys the seed weeds which may have come up amongst the barley or oats sown after the turnips. There are several ways in which the cultivation of light soils may be varied without adhering strictly to the Norfolk rotation, so as to introduce a greater variety of produce. Tares may be sown on the better sorts of light lands after a good tillage given immediately after harvest. If they are fed off or cut green in May and June, early turnips may be sown after them, which will be fit to feed off or draw for the cows in September, in good time for ploughing up the land for wheat-sowing. In this case the land gets all the ploughing necessary to clean it completely, and exactly at the best time. Three ploughings may be given after the tares if the land is not clean, and the turnips being well hand-hoed and horse-hoed, the land will be perfectly clean to receive the wheat-seed. Manure may be put on for the tares or the turnips; and if these are fed off with sheep, they will so enrich the soil, that the next crop cannot fail to be abundant. By varying the management of light land according to circumstances, and with some judgment, many more profitable crops can be raised than by the common simple rotation, in which a fourth of the land is sown with turnips. If this crop fails, which is often the case where it recurs so often, the whole system is deranged, and the loss is very great. The introduction of a greater variety of produce in the cultivation of light lands, in imitation of the Flemish practice, and the increase of stock kept in consequence, would be an important step in the improvement of British husbandry.

On heavy soils it is often impossible to keep the land clear of weeds, in wet climates and unfavourable seasons, without a complete fallow, and when this is the case it is best to do the thing effectually. Upon cold wet soils, which should always first of all be well under-drained, no pains should be spared to get the land perfectly clean: it should be exposed to the frosts of two winters and the heat of one summer and part of another, as already mentioned. [Arable Land.] Only one crop is lost by this method, and if the land is properly worked, cleaned, and manured in autumn, it may be sown with barley or oats in the spring of the second year. The crop will be ample, and the subsequent produce of clover equally so, and the land so clean, that, with proper manuring, several crops may succeed, such as wheat, beans, oats, tares, wheat, without the necessity of another intervening fallow. The advice we would impress on the minds of the cultivators is—Avoid fallows if you can keep your land clean; but when you fallow, do it effectually, and improve the soil at the same time by chalk, lime, or marl, according to circumstances. Do not spare either ploughs or harrows in dry weather. Lay the stitches high and dry before winter, and deepen the water furrows well with the spade. By following these rules the stiffest land may be brought into a good state of cultivation; and the farmer will not find, by the growth of weeds, docks, and thistles, that his labour and manure are thrown away, as is too often the case. Experience has fully proved that the air and the dews impart fertility to the soil, and that land which has been well fallowed and stirred requires less manure than it would otherwise do. Fallowing alone will not make up for want of manure, nor will manuring be sufficient without ploughing and cleaning the land properly, and exposing it to the influence of the atmosphere, especially in autumn and in spring: but a great saving of the one and the other may be effected, by judiciously varying the crops so as to admit of ploughing the land at different seasons of the year.

It is asserted by some old-fashioned farmers that the plough alone is sufficient for all the purposes of fallowing. This is a great error, which leads to useless and unnecessary labour. We would almost say that ploughing the fallows is never necessary, except to enable the drags and harrows to stir the land. The first ploughing of the stubble cannot be too shallow, and the harrows should be set to work before the wet weather sets in. When the surface is become mellow and clean, the land may be ploughed deep, and the soil below should be brought up and exposed to the air and frost all the winter. In spring the drag should begin the work again before the soil is hard. It may then be ploughed in narrow ridges right across the old stitches, or obliquely, and left for the influence of summer. The drags will level all these ridges when the manure is to be put on; and this being ploughed, the land is fit to receive the seed, if wheat is the crop intended. If it is left for barley, it must have another ploughing in spring, and be well harrowed before the seed is sown, especially if this is done by the drilling-machine. The clover or grass-seeds may be sown immediately after, and the land lightly rolled. There is no danger of making it too fine in spring. Without a fine tilth no good barley can be expected.

FARM. A farm is a portion of land which is set apart for cultivation either by the proprietor or by a tenant who pays a certain stipulated rent for it. We shall consider it in this latter sense; and, without entering into the mode of cultivation, we shall notice the circumstances which determine the profit that a tenant may reasonably expect to make in return for his trouble and outlay.

The first thing to be considered in taking a farm is the capital which the tenant is possessed of, or of which he can procure the use at a reasonable rate. If a man takes a farm without the means of stocking it properly, and is restrained in his first outlay, he will never be able to cultivate it with benefit to himself or to his landlord: he will be obliged to sell his produce at a loss, to over-work his cattle, and to keep a smaller quantity of stock, and consequently make less manure than is required to keep the farm in a productive state. It is not sufficient that he has the means of stocking the farm; he must have wherewith to pay the greater part of the whole expenses and the rent of the first year. In the present state of agriculture, a man who takes a farm of 200 acres of arable land, or land partly arable and partly good pasture, will require from 1600*l.* to 2000*l.*; and it is not the interest either of the landlord or the tenant that he should take the farm unless he can command that sum. The amount of capital required depends in a great degree also on the quality of the land; very rich land requires less capital in proportion to the rent than poor land, especially if the poor land requires draining, chalking, or marling before it will produce any tolerable crops. All these circumstances must be taken into consideration before a farm is hired.

When it is ascertained what extent of farm may be safely undertaken with a given capital, the most important object to be attended to is the condition and fertility of the soil, not only with respect to the natural quality of the land, but the actual state it is left in by the preceding system of cultivation. A moderately fertile soil, in good condition, will give a greater profit for several years than a better soil which is partially exhausted and rendered foul by injudicious management and over-cropping. For this purpose it is necessary to ascertain what has been the state of the crops for several years before, how the land has been ploughed, and whether the crops have been heavy with or without manure. There is no method yet found out of ascertaining the comparative state of land which has been exhausted. It would be a discovery well worth the attention of modern chemists, who have made such progress lately in the analysis of vegetable substances, and would be invaluable to farmers and proprietors of land. In the mean time the nature of the weeds which abound on the land will give some clue to its state; and an experienced person will collect from various minute appearances in the soil whether it has been fairly managed or exhausted. It is in general more advantageous to take a farm in a district with which you are well acquainted. It will be a great advantage if you have had an opportunity of seeing the land at all times, observing it in different seasons and states of the weather, and especially of seeing the crops thrashed out, and ascertaining the quantity of corn which is usually yielded from a certain quantity of straw, for lands very similar in outward appearance will produce a very different return when the crops are thrashed out. A want of attention to these circumstances is the cause that a man who comes from a distant part of the country and hires a farm on his own judgment seldom succeeds so well as might be expected, even with a superior knowledge of agriculture. He naturally compares the soil with some similar soil which he has been acquainted with. If he comes from a district where the soil is sandy, and where clay is in request, he will give the preference to very stiff loams; if he comes from a cold wet clay, he will prefer the sandy; and the chances are, that he is mistaken in his judgment, and finds it out when he has already embarked his capital in a losing concern. Next to the nature of the soil is to be considered the convenient situation of the farm, the disposition of the fields, and the adaptation of the farm-buildings to the most profitable occupation of the land. The roads, especially those which lead to neighbouring towns, whence manure may be obtained, are a most important object; and if there is water-carriage, it greatly enhances the value of the farm. The roads to the fields, and the distance of these from the farm-yard; the convenience of having good pasture, or land easily laid down to grass, near the homestead, and especially the situation of the farm-buildings with respect to the land, and the abundance of good water, are all circumstances which must be well considered, and which will greatly influence the probable profits, and consequently the rent which may be fairly offered. A central situation is no doubt the most advantageous for the farm-buildings, as greatly diminishing the labour in harvest and in carrying out manure. But there may be circumstances which render some spot nearer the extremity of the land more eligible, and it is only when entirely new buildings are to be erected that there is a choice. The old farm-buildings are generally in low and sheltered situations, but it is a great inconvenience to have to carry the manure, which is the heaviest thing carted on a farm, up a steep hill. The best situation is on a moderate slope, neither in the lowest nor highest ground.

The disposition of the buildings is of great importance both to the landlord and tenant. Large straggling buildings are inconvenient, and cost much in repairs. The house should be neat and comfortable, fit for the residence of a farmer who has a capital such as the farm requires. The rooms should be airy and healthy, facing the south, with a neat garden in front of the house. The farm-yard should be to the north, behind it. Near the house and the farm-yard there should be a small paved court separated from the yard by a low wall. In this court, which should communicate with the dairy, the utensils may be placed on proper benches to air and dry in the sun. The architecture of the buildings may be left to the taste of the proprietor or his architect. The simpler it is, the more appropriate. The yard or yards in a large farm should be sheltered on the north side by the barns, which need not be so extensive as used formerly to be thought necessary. If there is a thrashing-machine, a single floor to thrash the seeds upon, and to employ the men occasionally in winter, is quite sufficient. Every farm which is so extensive as to require more than one floor to thrash the corn on ought always to have a thrashing-mill attached to it. [Barn.]

A small yard, distinct from the other, with sheds for the cattle to shelter themselves under in wet and stormy weather, is a great advantage, and may be added at a trifling expense to any set of farm-buildings. The cart-sheds should be in the stack-yard, which properly occupies a space north of the barn. There should be a sufficient number of stands with proper pillars and frames to build stacks on. Each stack should be of such a size as to be conveniently taken into the barn to be thrashed out. The round form, and the square, which becomes nearly round when built up, are most convenient. Nine stone or cast-iron pillars with caps over them are placed on brick foundations, and support a strong frame on which the stack is built. In the centre of the stack there is usually a pyramidical open frame, to allow the air to circulate through the stack, and prevent the heating of the grain. On each side of the yard should be placed the stables, cow-houses, and feeding-stalls, with a pump of good water near the last, and convenient places to put hay, straw, and turnips in, with a machine to cut them. A great deal of time and labour is saved by a proper arrangement of the different parts of the farm-buildings. An under-ground cistern near the cow-house and stables, into which the urine and washings of the cow-house may run by means of a sink or drain, is a most useful appendage, which is too little thought of in England, whereas it is one of the most indispensable parts of a Flemish farm. It supplies a kind of manure, which can be applied to the land at all times, which invigorates sickly crops, and may often produce an abundant return, where otherwise there would be a complete failure. There are many plans of farm-buildings given in works on agriculture, which combine all that is useful on a large scale. Most of these plans have been executed at a great expense for the farming establishments of noblemen and men of large fortunes. They may be considered as the palaces of husbandry, where much is expended for the sake of grandeur. But the proprietor who desires to erect buildings most proper for the occupation of his land must study economy, and lay out no more in buildings than is necessary. They should be so substantial as not to require frequent repairs; without unnecessarily increasing the original expense of materials and labour. Light thatched roofs are sufficient for the sheds and smaller buildings, and even for the cow-houses and stables; but the waste of straw and the danger from fire should be set against the cost of tiles or slate as a covering. The barn should not be thatched, unless it can be done with reeds, which form a durable and impervious covering, not subject to be infested with rats. The house should always be detached from the farm-buildings, and should have a tiled or slated roof.

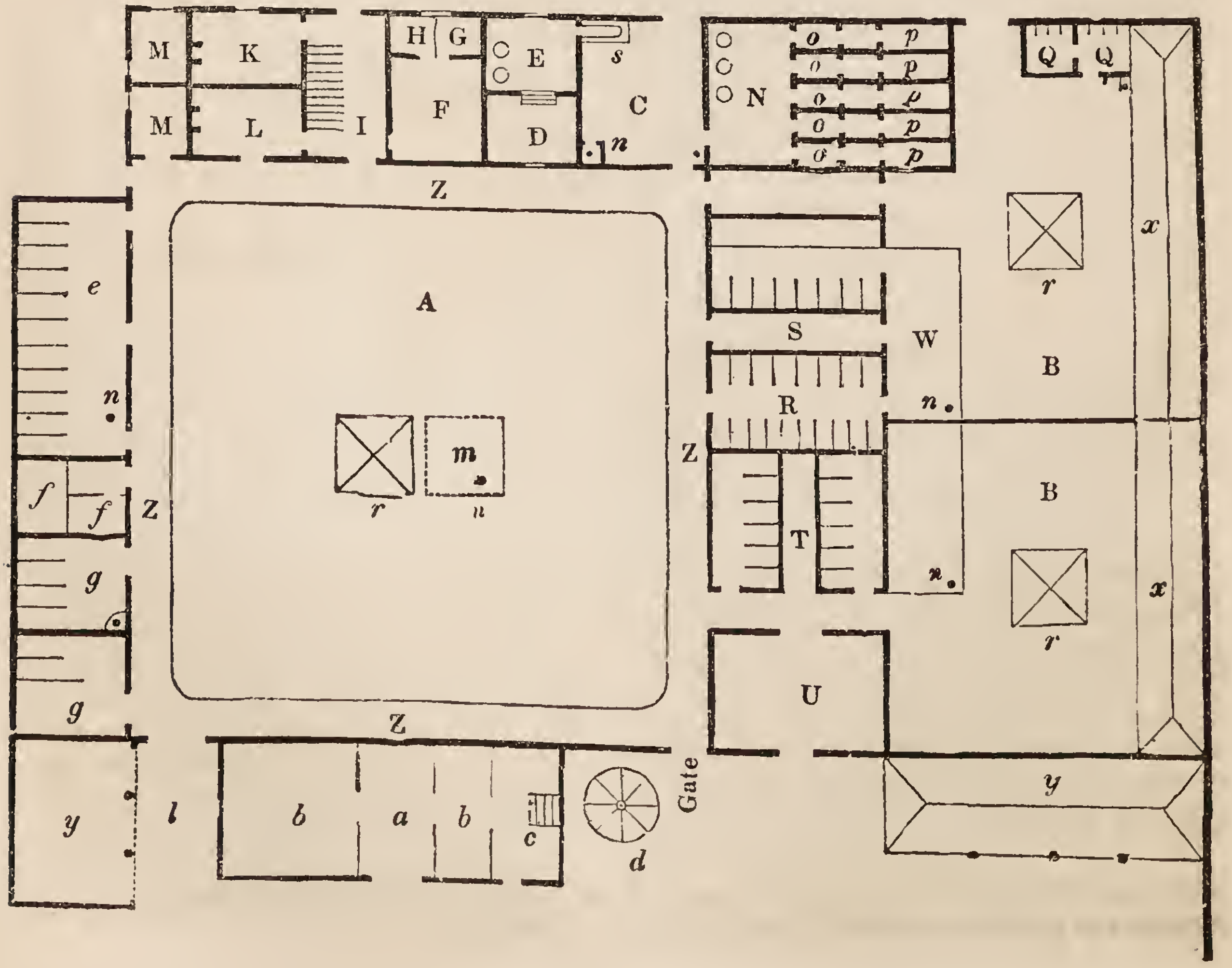
We here give a plan of plain farm-buildings for the occupation of 200 or 300 acres of land, of which two-thirds are arable, fit for turnips, barley, clover, and wheat. The farm-house should have a large kitchen, two good parlours, and five or six bed-rooms; a wash-house, with coppers to brew; a scullery, and larder. The dairy should communicate with the house, and with a small paved court, near which are the pig-sties and the cow-house. There should be two distinct farm-yards with proper sheds, and in each there should be a cistern for the urine from the stables and the drainings from the dung.

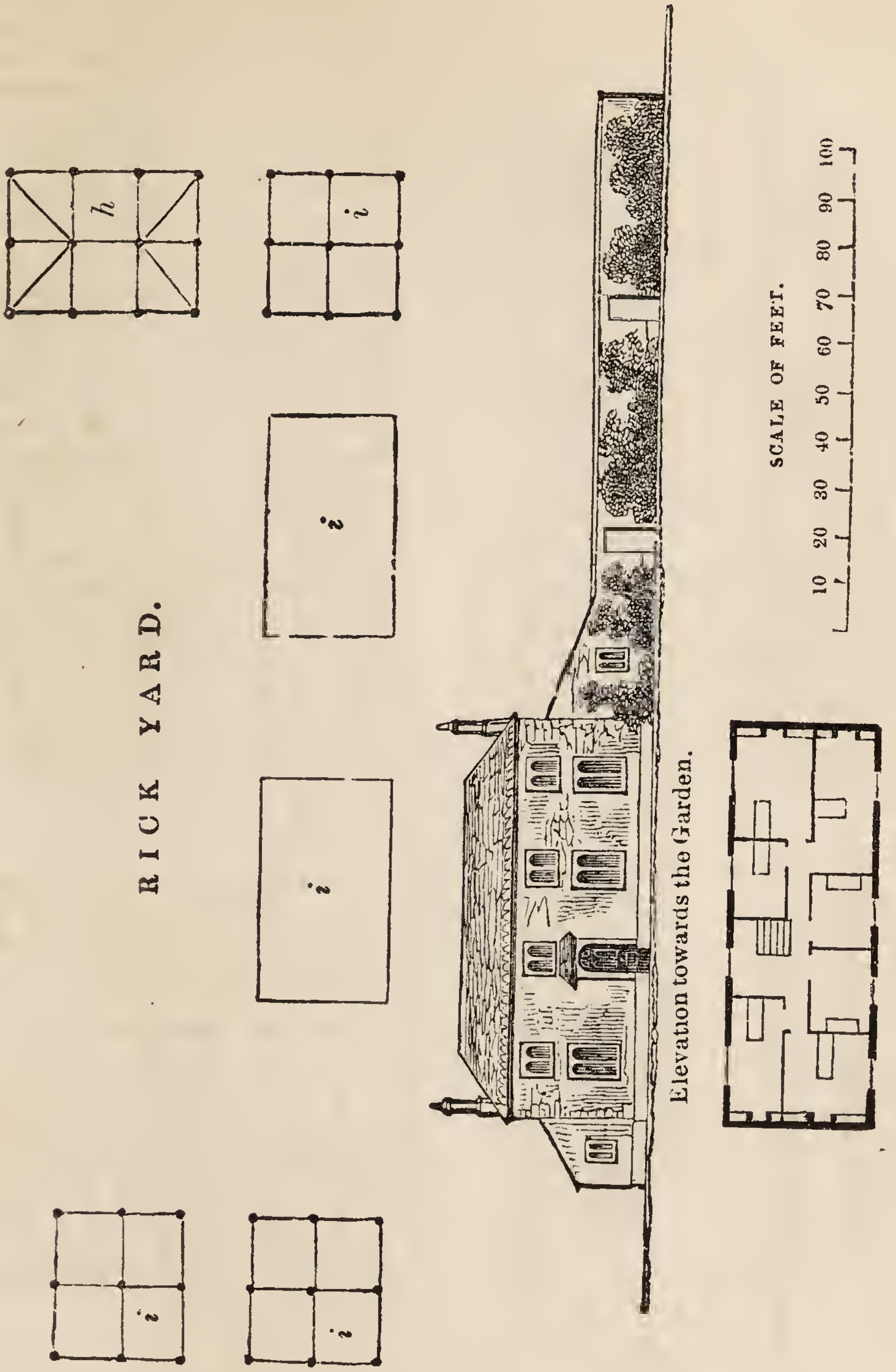
For a small occupation, where the tenant is but a little above the rank of a day labourer, a set of buildings all under one roof, and forming the longer side of the yard, which may have open sheds round it, such as is represented in the annexed plan and elevation is at once convenient and economical. If this building is thought too long, it can very easily be divided into two, which may be placed at right angles to each other and form two sides of a square. The farm-house and cow-house might form one side, and the stables and barns the other. This is the more common distribution in Flanders.

These two examples of farm-buildings will be sufficient to give some idea of what may be proper for farms of an intermediate size. A principal thing to be attended to is to have plenty of room for cattle; and where old barns remain much larger than is required according to the present mode of stacking corn in the yard, they can be very advantageously converted into cow-stalls or ox-stables.

Where many sheep are kept, it is of great advantage to have a sheep-yard, with low sheds all round, at the time when the ewes lamb, especially when the season is wet and chilly, which hurts them more than a dry frost. The second yard B is well adapted for that pur-

Buildings for a Farm of 300 *acres.*





A, principal yard; B, second feeding-yard, divided; C, small paved yard adjoining the dairy and piggery; D, dairy, two feet under the level of the yard; E, wash-house and brew-house; F, kitchen; G, skullery; H, larder; I, entrance and stairs; K, best parlour; L, second ditto, cellars under them; M M, coal and wood house; N, steaming-house for pigs; Q Q, hen-houses; R, calf-pens; S, cow-house for sixteen cows, with a passage through it; T, bullock-house; U, root and straw-house to cut turnips, chaff, &c.; W, cistern, divided into two by a partition, sunk seven feet and vaulted over; Z, paved road round the yard; *a*, barn floor; *b b*, bays; *c*, raised floor and thrashing-mill; *d*, horse-race; *e*, horse-stable; *f f*, loose boxes; *g g*, spare stables and chaise-house; *h*, granary on stone-piles; *i i i i*, corn-stacks; *l*, entrance to the yard; *m*, tank covered over; *n n n*, pumps; *o o o*, pig-sties; *p p p*, small open court to each sty; *r r*, feeding-cribs; *s*, oven; *x x*, open sheds for cattle; *y*, cart-sheds.

pose; and an additional temporary shed against the partition which divides it into two will convert either division into an excellent sheep-yard.

Flemish Farm Buildings.

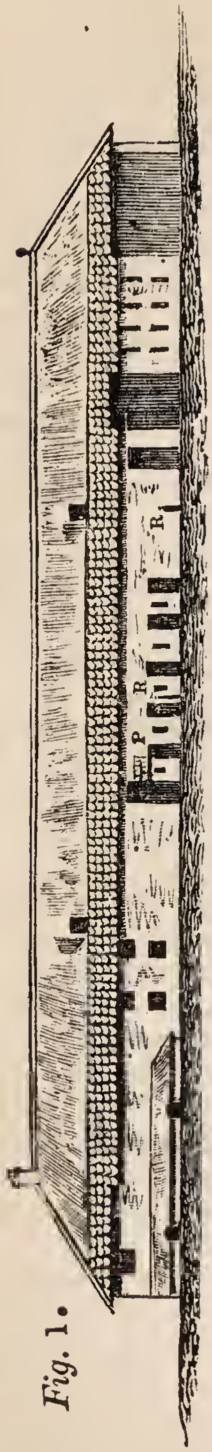


Fig. 1.

Elevation towards the yard.

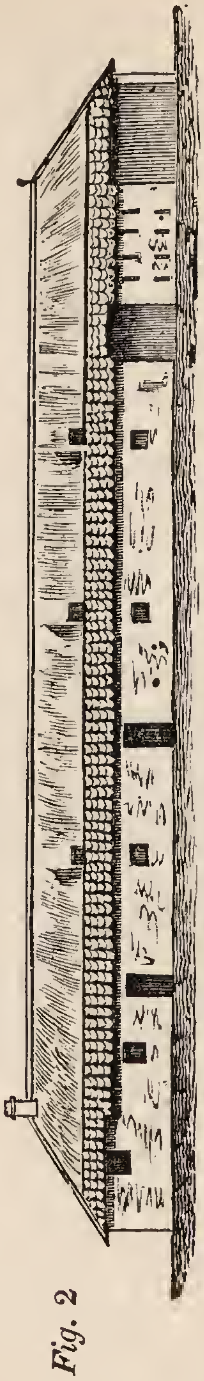


Fig. 2

Elevation towards the orchard and garden.

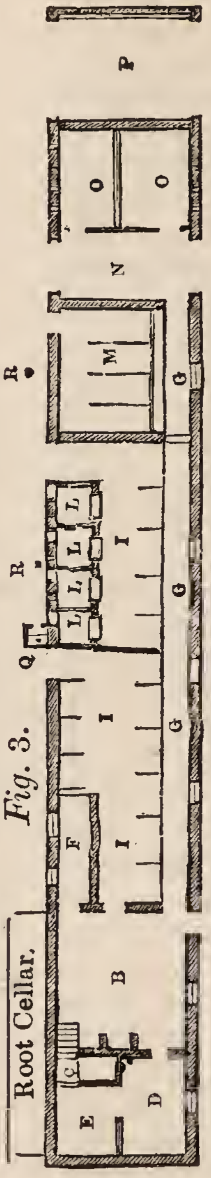


Fig. 3.

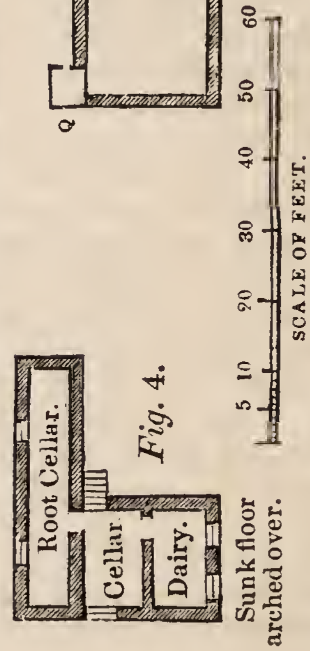


Fig. 4.

Sunk floor arched over.

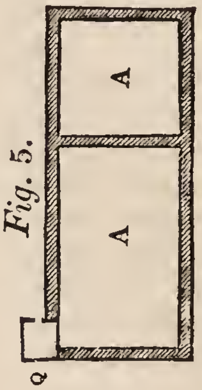


Fig. 5.

A A, Urine tank, under the stable and cow-house, 50 feet by 20, and 6 deep, with a partition in it.
Q, privy.

Fig. 1. P, privy; R R, pumps for urine. *Fig.* 3. B, kitchen; D and E are sleeping-rooms raised a few feet above the kitchen and over the dairy and cellar; F, a work-shop for weaving and other work; G, passage to feed the cattle; H, cow-house; L L, pig-sties; M, stable; N, barn-floor; O O, bays; P, cart shed; Q, privy; R R, pumps for urine.

In valuing the rent of a farm, the habitation of the farmer is seldom taken into the account, and it ought not to be above the station of the tenant; but the buildings immediately connected with the cultivation necessarily add to the rent or diminish it, as they add to or diminish the profit.

The next important question is what may be a fair rent both to the landlord and the tenant. This depends as much on the mode of cultivation adopted as on the fertility of the soil. The tenant must have a fair interest for his capital, and a fair remuneration for his trouble. In the old system a third of the gross average produce was considered as a fair rent, including all the direct payments for the occupation of the land, such as tithes, rates, and taxes; another third was supposed to cover the labour and expenses of the farm and interest of capital; and the remaining third was appropriated to the maintenance of the farmer and his family, out of which he had to save whatever he laid by as a clear profit. But this calculation is no longer applicable to the present state of agriculture. The expenses are greatly increased, and the produce is also greater. It requires a greater capital and more skill to manage a large farm. The tenant is a man of a more liberal education, and his habits are more expensive. The occupier of 500 acres of land in England expects to live as well as a land-owner of 500*l.* a year income. He cultivates better by applying more labour, and much of the produce is owing to his skill and his capital. He therefore expects a greater share of the produce than the landlord, not only to repay his outlay, which is greater, but to live upon. Supposing the tenant to have a capital employed equal to ten times the rent, which is often the case, the gross annual produce ought to be equal to five times the rent. This we shall distribute as follows: two-fifths for expenses, including rates, tithes, labour, and interest of capital at 5 per cent.; one-fifth for rent; one-tenth for improvements and purchase of manure; and three-tenths for the net profit of the farmer, out of which he is to live. This appears a less proportion than the old third; but it must be remembered that the produce is greatly increased. It will be found, wherever accurate accounts are kept and a farm is skilfully managed, that the proportions above stated are not far from the truth. It requires much judgment and experience to calculate what average crops may be expected by an improved mode of cultivation, and especially by increasing the number of cattle and sheep maintained on the farm.

In Scotland it is notorious that rents are much higher than in England, not only for small occupations, but for extensive farms; and that the tenants have complained less of the times than their neighbours in the south. It may be worth while to inquire into the cause of this, for the low price of corn must affect the Scotch farmer equally with the English. One great difference between the Scotch and the English farmer is, that the former gets work done at a cheaper rate than the latter. The Scotch labourer is fully as well fed, and clothed, and lodged as the English; but he has less money to spend at the alehouse. He is paid, not in a certain sum every Saturday, but in comforts, in the keep of a cow, in a certain number of rows of potatoes, a certain quantity of malt to make his beer, a cottage to live in, and a meal to feed his family. His immediate wants are supplied, and he is comfortable; the consequence is, that he works willingly. He has no remnant of the last night's debauch at the beer-shop. He is early at work, and he does his work cheerfully. The horses of a Scotch farmer are well fed; they are always in good condition. They work ten and even twelve hours in a day at two yokings. The ploughman only thinks how he shall finish his work in proper time, and unless he makes the horses work as much as they can without distressing them, he knows he shall not get through his work. All this is worth 25 per cent. on the whole labour of the farm, as Arthur Young has very judiciously calculated, when he gives the expense of labour on the farm of a gentleman, compared with that on the land of a farmer who works with his men. (See *Farmer's Guide.*) The moral effect of an interest in the work to be done, when opposed to that of a perfectly distinct and often hostile interest, will readily account for so great a difference.

But besides this, the Scotch farmer has generally the advantage of a scientific education, and of a thorough knowledge of the principles of his profession; and with the shrewdness peculiar to his country, he knows how to take advantage of every favourable circumstance. He has also been taught to calculate, and will soon discover where there is a profit or a loss. This has made him turn his attention to cattle and sheep of late years, more than to the production of corn; and the Scotch have found, that while a very decent profit was made on the cattle, their land produced more corn, although it sold at a lower price; for the green crops raised for the cattle, and the manure made by them, enriched the land so much, that the average produce on some light lands was nearly doubled. All this kept up rents to a much higher level than in England, where prices were low, and there were no means of diminishing expenses or increasing produce. Hence rents in Scotland have kept up wonderfully, when we consider the great fall of rents in England since the peace.

The price of agricultural produce throughout Great Britain and even Ireland is brought very nearly to an equality, the only difference being occasioned by the means of transport. But the price of labour still varies much, and this is owing to local circumstances, which it is hoped will gradually cease. While the very unequal distribution of the expense of the maintenance of the poor was not remedied, adjoining parishes might differ in any proportion with respect to the actual price of labour; and before a fair rent could be calculated, it was necessary to consider how much of the value of the labour was paid directly, and how much in the shape of rates. Our northern neighbours were free from this uncertainty.

Farm Accounts. In proportion as the management of a farm requires more skill, and the various operations become more complicated, so the necessity of great accuracy in the accounts becomes more evident. The manner in which farm accounts should be kept deserves therefore particular attention.

Many farmers, who are not devoid of intelligence, and who are anxious to ascertain their gain or their loss in cultivating the land which they have hired, have no other means of ascertaining this than the balance of their account of receipts and expenditure. If they have separated the accounts of their private establishment from that of their farm, they think that they have done all that is required, and at the end of the year they can tell accurately how much they have gained or lost by their farm. But ask them to account for this gain or loss, and they can give no answer. If a tradesman, who has a capital in business equal to that of a farmer of a considerable number of acres, were to keep accounts in this manner, and become a bankrupt, no one would hesitate in saying that he failed because he kept no regular accounts. He had no greater stake than the farmer, and his transactions were perhaps less varied: if he kept no clerk, he should have attended better to the accounts himself. The same may be said of the farmer; and if a man who has a floating capital of 2000*l.* does not think it worth his while to employ a clerk to keep his accounts, not having time to do so himself, it is no great wonder if he is involved in difficulties. But it may be said that agricultural accounts are very simple, and that any one can keep them. So are merchants' accounts at first sight. Nothing is simpler than to put down what is bought and sold, what is the profit on each transaction, and the sum is the profit of the whole. But merchants know that to keep this very simple account many books, many entries, many checks, and consequently many clerks are required. In a lesser degree this is true in a farm. It is easy to know what is bought and sold; what is expended or produced; but it requires very minute accounts to ascertain what part of the farm gives a profitable return, and what is the cause of loss. There may be a profit on the crops and a loss on the stock, or *vice versâ.* The money expended on improvements or adventitious manure may have produced an increase which is proportionate to the outlay, and which affords a good interest; but it may also be a decided loss. How is this to be ascertained, except it be by accurate accounts? The expense of keeping accounts is much over-rated. A clerk who has his board and 30*l.* a year is generally a young man who has some education. He is useful in seeing that the operations ordered by the farmer are duly executed. He is a trusty overseer, and, as he has his accounts in his thoughts, he is most likely to detect the cause of any loss from a want of attention in subordinate agents;—his salary is therefore well earned, and the farmer will not think it thrown away. In whatever manner the accounts are kept, whether by the farmer himself or by a clerk, method is of great importance: and whatever may be said against it by those who do not know its value, there is no system of accounts which can be compared with the well-known method of double entry, as it is called, which is of Italian invention. The principle of this method is so simple that the slowest arithmetician cannot be confused by it, and it is so perfect that no error can escape its scrutiny. As applied to agricultural accounts, which are simple in their nature, it becomes so clear, that if once adopted, it is impossible that it should ever be abandoned. The satisfaction of a perfect proof of the correctness of the accounts is so great, that no one who has ever experienced it will be satisfied with any other method.

To give a general and comprehensive notion of the system of double entry, to those who are unacquainted with it, would lead us from our present purpose; suffice it to say, that every account is checked by another, in which the same entry is made in a different manner. The sum of all the entries must be equal on each account: and consequently any inequality indicates an error somewhere, which may be detected.

In the accounts of a farm there are many separate items to be taken into consideration. There may be a separate account kept for every field. There should always be one for every crop of which the rotation consists. There is an account of the labour of men and horses; of the produce of the dairy; of the stock purchased to be fatted, or sold again in an improved state. In short, the divisions of the general account may be increased without limit. The more subjects there are to furnish items for an account, the more difficult it is to strike a balance, but with a little attention and perseverance it may be done; and he who keeps very correct accounts will always be the first to discover any impending evil, and to take measures to provide against it.

The basis of all the accounts is a daily journal of every transaction, which must be collected from all the labourers and agents employed. M. de Dombasle, at his celebrated farm of Roville, in France, has all his principal servants and his apprentices assembled every evening after the day's work is over. Each man gives an account of the work done by him or under his superintendence, which is written down by the clerk. The orders for the next day are then given, and every one returns to his lodging or his home. In the course of the next day the clerk enters all that is in the journal into a book, where every person employed has an account: every field has one; every servant and domestic animal has one; and every item which can be separated from the rest is entered, both as adding to the account or taking from it. For example, the milk of the cows is entered daily. The quantity of butter, buttermilk, and skimmed milk which it produces is also entered; and these two accounts check one another. Any error is immediately detected, and the knowledge of this prevents mistakes. An entry should be made of every particular operation in each field, that the farmer may know which is his most profitable land. The number of ploughings, the quantity of manure, the state of the weather, and all other circumstances which may influence the return, should be carefully noted, in order that it may be clearly seen whether any experiment or deviation from the usual routine is advantageous or otherwise. Thus all real improvements may be encouraged, and uncertain theories detected by the result.

The most important circumstance which influences the profits of a farmer is the cost of his team and the wages of his labourers. These vary in different situations so much, that they greatly influence the rent which he can afford to give for the land. In some parts of the country the horses are pampered and kept so fat that they can scarcely do a day's work as they ought. In others they are over-worked and badly fed. Either extreme must be a loss to the farmer. In the first case, the horses cannot do their work, and they consume an unnecessary quantity of provender; in the other, they are soon worn out, and the loss in horses that become useless or die is greater than the saving in their food or the extra work done by them. A horse properly fed will work eight or ten hours every day in the week, resting only on Sundays; by a judicious division of the labour of the horses, they are never over-worked, and an average value of a day's work is easily ascertained. This, in a well-regulated farm, will be found much less than the common valuations give it. It is here that most of the errors are to be detected in the accounts of the expense of cultivation given in evidence before parliament, without any intention to deceive in those who gave the accounts. There have been printed forms invented, in order to render the accounts more simple as well as more comprehensive. Forms may be of use to enter minute details; and each superintendent labourer may have a form of entry for the work which he performs or superintends; but the ledger should be kept exactly as that of a mercantile man, and be frequently balanced to ensure correctness. This is a thing which cannot be too strongly recommended to young farmers.

When a farm has been agreed for as far as rent is concerned, there are always conditions in a lease, which it is of great importance to the farmer to understand fully. It is necessary that the landlord should have some security against the wilful deterioration of his land by a dishonest tenant, but agents are too apt to cramp the tenants by prescribing the exact mode of cultivation, without giving the tenant sufficient scope to try improved methods, which may ultimately be highly beneficial to all parties. If the landlord can ensure that the proper quantity of manure is put on the land every year, and that it shall be well tilled and kept free from weeds, he need not have any other protection, unless it be for the last two or three years of the lease, when the tenant might be induced to over-crop the land, and thus exhaust it.

In entering on a farm there is often a heavy demand on the in-coming tenant for work done by the predecessor, for a supposed remainder of manure, and various other items, which are usually settled by reference to the custom of the country. Some general rule is required to regulate all these demands, which are often exorbitant, and cripple the in-coming tenant in his capital. It is just that an out-going tenant should be repaid for any permanent improvement which he has made, and of which he has not reaped the whole advantage, and that he should be encouraged to keep up the proper cultivation of the land, so that the in-coming tenant may be able to continue the regular course. But this he will not do, unless he expect to be remunerated. On the other hand, it is also just that the in-coming tenant should not pay for work slovenly done, or for supposed remnants of manure which do not exist in the land. We have known instances where the valuation of all the items to be paid for by the in-coming tenant greatly diminished his capital and crippled his operations for several years. There should therefore be a separate stipulation on this head before a farm is finally hired.

FENCES are necessary wherever cattle are depastured and properties divided; and according as they are intended to prevent men or cattle from trespassing over them, they are formed of various materials and dimensions.

When a park is enclosed to keep in deer or game, the best fence is a stone or brick wall, well built with lime-mortar; but as this is expensive where stone and lime are not at hand, the common *park-paling* is more frequently met with. This is composed of posts and rails of oak mortised and pinned together, and split pales of the same material nailed upon these in an upright position. The pales are split out of the trunks of oaks, where there are no branches or knots, when the sap is still in them. They are about half an inch thick, and with feather edges, that is, diminishing in thickness from one side to the other: their usual width is five inches. When they are nailed on the rails, which are usually of a triangular form, the thickest edge of one pale is nailed over the thinner edge of the preceding, forming thus a very close fence. Every alternate pale is placed three or four inches higher than its neighbour, which gives the top of the fence a castellated form. This is not done merely for the appearance; but it makes it more difficult to climb over, and the deer are not so apt to leap at it as if the top were a straight line. The distance between the post is usually nine feet; and the three rails with the pales nailed on them is called a pannel, and may be conveniently moved at once when any alteration in the fence is required. A whole fence may be moved at a small expense, merely by digging out the posts, and placing them elsewhere. The pannels come in regularly, and are pinned into the old mortices in the posts. Sometimes the pales are nailed at a distance from each other, which makes the *open-paled fence*, and the pales are then generally cut to a point at top. This fence is peculiar to Great Britain and Ireland, and is very seldom found on the Continent.

In the Jura and the Alps, where wood abounds, a rough fence is frequently made with strong split pieces of wood, which are fixed obliquely in the ground and supported at the upper end by two others placed in the form of a cross. It is not a very strong fence, but it is sufficient to prevent the cows from straying, for unless a bull with his horns makes a gap in it, they will not attempt to pass it.

In wild mountain pastures in Scotland and Ireland, it is usual to separate the properties of different individuals or that of parishes by rough stone walls put together without any mortar. The materials are generally at hand, and a rough and efficient fence is made without much labour.

Some of these walls are built with considerable skill and are very durable; especially if the stone is of a nature to split with a flat surface, in which case a dry wall may be built which has all the appearance of one built with mortar. Sometimes a layer of mortar is laid on the stones at a little distance from the ground, and another near the top. The coping is usually made of flat stones, which are sometimes placed on edge in a direction across the wall, and wedged together along the top of it or set in mortar, forming a very rough coping, which it is not easy to get over.

Where stones are not at hand, or less trouble is taken, a high bank of earth faced with sods of grass is substituted for a wall. This is not so durable and is more easily surmounted, unless a hedge of some kind be planted along the top. Furze seed is often sown for this purpose, and soon forms an excellent fence, which by proper care and clipping will last a long time. But the most common kind of fence for fields is the hedge and ditch, the bank being raised with the earth and sods taken out of the ditch, and the hedge planted on the side of the bank towards the ditch or on the top. Sometimes there is a ditch on both sides. In flat wet lands this last is extremely useful, not only as a fence, but as a drain for the superfluous water. When the ditch is intended to carry off the water, and there is only one, it is of consequence that it should be so placed as to answer this purpose effectually; it should therefore always be on that side of the bank where the ground rises, for otherwise the bank will impede the natural flow of the water, and it will be necessary to cut through it in different places to let the water running from above have an outlet into the ditch. In some extensive inclosures of land great inconvenience has arisen from the neglect of the surveyor in not attending to this circumstance, and setting out the bank on the upper side. Where they are not required as drains, it is a great waste of land to have any ditches, and a simple hedge planted on the surface of the soil is much to be preferred. Of all fences, a live hedge, which is carefully planted, and kept properly cut and trimmed when it is grown up, is by far the best. [HEDGE.]

When a fence is required within sight of a dwelling, and it is desirable for it to be concealed, a deep ditch is sometimes dug, and a fence placed in the bottom of it at such a depth as not to appear above the level of the ground. This is called a *sunk fence*. Sometimes a wall is built against a perpendicular side of a ditch, and some very light fence is placed obliquely outwards near the top of it and level with the ground. This is called a *ha-ha fence*, a name given to it from the surprise excited in a person unacquainted with it, when he suddenly finds himself on the top of a wall with a deep ditch before him. When it is desired to keep off sheep or cattle from a lawn or pleasure-ground without obstructing the view of the park or the fields, the ha-ha fence is very useful. A variety of *light fences of* *iron* have been invented for the same purpose: some of these are fixed and others moveable; some have upright pieces of cast-iron as posts let into oak blocks sunk in the ground, and rods of wrought-iron passing through holes in the uprights; some have wire for the same purpose. But the most common iron fence is composed of separate wrought-iron hurdles which may be moved at pleasure, and are kept together by screwed pins and nuts. They are merely stuck into the ground, for which purpose they have the ends of the uprights sharpened and bent so as to form a foot. By having this bend alternately on the right and on the left, they form a very firm basis when two hurdles are joined, the left foot of the one being strengthened by the right foot of the other. A very neat fence may be made at a small expense by using as posts pieces of young larch-trees four or five inches in diameter, with the bark on, and passing iron rods through holes bored in them at certain distances from each other. A fence of this kind, five feet high, with five horizontal rods five-eighths of an inch in diameter, is an excellent protection against cattle, and takes up no ground.

The greatest objection to the ditch and bank fence is that it takes up so much room. If the ditch is three feet wide, the bank will be the same. There is a foot along the ditch, and another along the bank, where the plough cannot reach; there are therefore eight feet lost. If the fields are squares of ten acres each, which is a convenient size, each field will have 1320 feet of fence in length, taking up 10,560 square feet of land, which is nearly a quarter of an acre. If to this be added the outer fences against roads, woods, or commons, it will be found that nearly one acre in twenty-five is taken up by banks and ditches. It is therefore a great saving to have a simple hedge without any ditch, wherever the land is well drained or has a porous subsoil.

It is usual in England to plant trees in the hedge-rows; and it is owing to this practice that England presents such a rich garden-like appearance, wherever there is a hill which enables one to see any extent of country. But trees are a great detriment to the farmer; and where the land is highly manured, the trees draw off much of the rich juices. The prudent tenant considers this in the rent; and although the landlord may now and then sell some timber, he pays dear for it in general by the annual deduction from his income on their account. Stone walls have a dreary appearance to the eye, but they are excellent fences; they take up little ground, they draw nothing out of the soil, they harbour no birds, and they are the best shelter against cold winds in spring. In an agricultural point of view, therefore, walls are to be preferred, unless the soil be favourable to the growth of the white-thorn or the holly; for clipped hedges are kept up at a much smaller expense than walls; and where there is no ditch, hedges take up as little room.

When hedges are preferred, whether with or without a bank and ditch, they must be protected until they are of a certain age; and for this purpose there are particular kinds of fences. When there is a bank and double ditch, and the hedge is planted on the top of the bank, which makes by far the most efficient fence, there are usually two fences, one on each side of the bank. These fences are made of rough posts, and rails mortised into the posts. The posts are a foot or 18 inches in the ground, and 2 feet 6 inches out. They are placed in the side of the bank, inclined somewhat outwards, about 4 feet 6 inches asunder. The two rails are let into mortices in the alternate posts, and nailed to the middle post, which is rather slighter. Thus a very formidable fence is made, which those who follow the diversion of hunting, and are not very well mounted, dread to encounter. If there is only a single ditch, it is usual to plant the hedge in the side of the bank a little above the level of the ground. To protect the young thorns from being cropped by the cattle, it is usual to make a dead hedge of stakes with bushes and brambles interwoven on the top of the bank: and if there is pasture land on the side where the ditch is, a post and rail fence is put up along the edge of the ditch till the hedge is grown sufficiently not to be injured by the cattle. When branches of thorns and bushes only are used without stakes, it is called a *foot hedge;* when the branches are interwoven, and the top of the hedge is finished with rods wattled in, it is called a *stake and edder hedge.* Wherever neatness and durability are consulted, the stake and edder hedge is always preferred.

Besides these common fences, there are various others of a light or temporary nature, which are chiefly used in gardens and pleasure-grounds, and also when sheep only are to be kept out, or when a new quick hedge along an orchard or garden has been planted. A cheap and neat fence of this kind is made with stakes only planted in the ground, forming a series of St. Andrew's crosses: or with osier or hazel rods worked between stakes like basket-work, either horizontally and lightly or obliquely and closely. When the rods are split, the appearance is still neater and lighter. A variety of light iron fences made of slender rods or wire have been invented to protect flower-gardens or shrubberies from the depredations of hares and rabbits, and their forms differ according to the fancy and taste of individuals.

FLANDERS AGRICULTURE.—Flanders was remarkable for the cultivation of its soil long before any other country north of the Alps or Pyrenees. This was the natural consequence of its commercial prosperity: and although very little change has taken place, and very few improvements have been introduced for more than a century, it still ranks foremost among agricultural countries.

It is not the richness of the soil which is the cause of the abundant harvests which the Flemish peasants reap, but their indefatigable industry. The greater part of the land in Flanders is naturally poor; and in extensive districts, which now have the appearance of the greatest richness at harvest-time, the original soil was once little better than the blowing sands which are met with in the neighbourhood of the sea. Neither is it a genial climate which brings forward the fruits of the earth in abundance; for the climate is inferior to that of France or the southern parts of Germany; and if there are not so many or so sudden changes of weather as in Great Britain or Ireland, the winters are longer and more severe. The average temperature in summer may be somewhat higher than in the counties which lie in the same parallels in England, and the time of harvest somewhat earlier; but this does not make a difference of more than a week in the maturity of every kind of grain. The winters are more severe in ordinary years, and the snow lies longer on the ground.

The soil may be divided into two classes. The first consists of the alluvial clay-loams near the coast; the second, of various sands and light loams which are found in the interior. The most fertile is that of the lowlands which have been reclaimed from the sea by embankments: it is chiefly composed of a muddy deposit mixed with fragments of marine shells and fine sea-sand. These lands are called polders, and their great natural fertility causes them to be cultivated with less art and industry than those lands which are much inferior.*

The cultivation in the polders has nothing remarkable to entitle it to much notice. Barley seems peculiarly suited to the soil, and very heavy crops of this grain are obtained, especially in those polders which, having been more lately embanked, are not much exhausted. Eight and even ten quarters per acre have been obtained with little or no manure; and the second crop of barley sown in succession has often been the best. Oats are also very productive and of good quality, from ten to twelve quarters per acre. But these heavy crops soon reduce the natural fertility, and after a few years the produce is greatly dimi-

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* The soil of the polders, when first brought into cultivation, gives by analysis the following proportions in its composition:—

Calcareous sand, mostly broken shells .	13
Silicious sand	5
Fine clay and vegetable matter . .	81
Soluble matter and loss . . .	1
	100

If this is compared with the soils as classed by Thaer [Arable Land], it will be found to resemble his richest wheat-soils, which he places in his first classes.

nished, and the land requires to be recruited by manure and cleansed by fallows. The usual rotation of crops in the polders consists of — 1. Winter barley after a fallow;—2. Beans;—3. Wheat;—4. Flax;—5. Clover;—6. Potatoes. If the potatoes have a favourable season, and the land can be cleared of weeds, the rotation begins again without a fallow year: but this is seldom the case, and the land is usually fallowed once in six years. The crops here mentioned are occasionally varied according to circumstances and manure, as well as the small quantity of dung made on the farm will permit. The polder farmer seldom thinks of purchasing manure; and even the ashes made by burning weeds are usually sold, to be sent to the poorer sandy soils, where their effects are more perceptible. They keep a sufficient number of horses to till the land, and often put four to a plough, which is the common turn-wrest plough, there called the Walloon plough. If this number is not absolutely necessary, they overlook the saving which might be effected, and pride themselves on the fat and sleek appearance of their team. No more cows are kept than are necessary for the supply of the family; and for want of winter provision for cattle few oxen are stalled. The dung is mixed in heaps, and turned over before it is carried upon the land. There are no tanks to receive the urine, this manure not being thought so useful in heavy soils as in the light. In short, the agriculture of the polders is far inferior to that of the interior, and not much advanced before that of the other nations in Europe. It is much inferior to that of Kent and Essex on similar soils. When the polders have been too much exhausted, they are frequently laid down to grass; and in a few years a very rich pasture is produced. If, instead of sowing only a few refuse hay-seeds from the lofts, proper grass-seeds were sown, after land has been cleaned by a fallow, the pasture would much sooner come to perfection, and several years would be saved; but the improved modes of converting arable land into pasture, so advantageously practised in the north of England and in Scotland, are almost entirely unknown in Flanders. The extent of the farms in the polders is from 100 to 250 acres. The farmers in general are in good circumstances, and the buildings substantial. There formerly existed a curious mode of letting farms, which still remains in some few places. The farmer hired the buildings and a portion of the land on his own account, and the remainder he undertook to cultivate on a joint account with the owner: that is, he did all the work, and the produce was sold on the ground: half of it went to the farmer and half to the landlord. No scheme could be more ingeniously devised to bring down the fertility of the soil; for it is evident that all the manure would go to that part of which the farmer had the whole produce. Accordingly this arrangement could only last for a short time, and on the newly embanked lands.

The air of the polders is unhealthy, and all those who are not inured to the climate are subject to fevers and agues. On this account land lets at a lower rate, and the wages of labour are higher in the polders than in more healthy districts.

In the interior of East and West Flanders the soil varies considerably; but the principal part is of a sandy nature. The sand, and a heavier loam which scarcely deserves the name of clay, are found much intermixed, which is owing to an alternation of layers of sand and loam, which are found by digging to a considerable depth. These layers are not of great thickness; and the accidental circumstance of the washing away of the sand in some places, and the depositions from the rivers in others, easily accounts for this variety. Some of the elevations, which are nowhere considerable, consist of a very poor sand, and suggest the idea of their having once been the sands of the sea blown into hills, as is observable on the coast. These hills, if they may be so called, are naturally so barren, that they were, not very long since, covered with heath, or at best planted with fir-trees: but they have gradually been cultivated and improved, and only a few remain in their original state of heath or wood. These elevations of the surface have determined the course of the principal rivers, and the hollow or basin in which each of these flows is marked with some peculiarity of soil. Thus the basin in which the Schelde flows from the borders of France to Ghent consists chiefly of a good loam, in which there is a considerable portion of clay. To the east of this is the basin of the Dender from Grammont to Termonde, which consists of the stiffest soil in Flanders; to the west, that of the Lys, which is a sandy loam. That of the Langelede, which is intersected by the canal from Ghent to Bruges and Ostend, is mostly a poor light sand; and lastly, in that of the Durme, which is a branch of the Schelde, and between it and the main river, a very low flat country, the soil is a light sandy loam enriched by the deposition of mud from antient inundation of the rivers, which are now confined within banks or dykes. In each of these districts almost every variety of soil occurs; but the general character is distinct, and the cultivation of the land is varied accordingly.

The poorer sands have been brought into cultivation chiefly by the persevering industry of small proprietors and occupiers. Without an abundance of manure nothing can be effected there, and consequently every attention is paid to the procuring and collecting of it. The first process is always to trench the ground deep with the spade, and level it by means of the mollebaert, an instrument peculiarly Flemish, of which a drawing and description are given in the article BARREN LAND. The next step is to procure liquid manure, which consists of the urine of cows and horses, the drainings from dunghills, and the emptyings of privies. The numerous towns and villages which are scattered over Flanders, and the canals which intersect the country in all directions, facilitate the collecting and transporting of manure. A regular trade is carried on in everything which can enrich the land; nothing which can be of any use for this purpose is lost or wasted. In every farm there is a large vaulted cistern, in which the liquid manure is collected, and where it is occasionally stirred to excite fermentation, and make it more efficacious when it is carried upon the land.

Experience has taught that manure put on light land in a liquid state is much more immediately effective than when the solid dung is ploughed in, but that its effects are also much less durable. This has led to the practice of frequently renewing the manure, and pouring the liquid over the growing crops as a top-dressing. Considerable care is required to give the proper quantity, and to regulate the strength according to circumstances; for too great a dose might destroy the crop, or produce great luxuriance on the leaf at the expense of the fruit or seed. The urine and other hot substances impregnated with saline particles are therefore diluted, if the weather is dry, before they are used, or they are poured over the soil some time before the seed is sown, that they may sink in and be more diffused.

At a distance from large towns it would be impossible to obtain the requisite quantity of manure, and accordingly it is made on the farm. The cattle are the principal source of the supply; but every expedient is resorted to in order to increase the quantity and improve the quality. Every kind of vegetable or animal matter is carefully collected, and made to undergo the putrefactive fermentation by being mixed with others already partially decomposed. Nothing excites heat and putrefaction more than urine when it is poured over substances subject to decomposition. In every farm-yard there is a cavity or pit into which the objects to be acted upon can be thrown, and into which the urine or drainings of the dung-hill can be made to flow: by frequently moving and stirring the mass, the decomposition goes on rapidly, heat is evolved, and the fibres and dried juices of vegetables are decomposed, and become soluble in water, in which state their effect on vegetation is greatest. The place in which this is going on is called in French a *croupissoir*, and in Flemish a *smoor hoop*. It is generally thought most advantageous that the manure should be ploughed into land in an active state of fermentation; and in order to secure this, it is in some places laid on the land in heaps, and each heap is moistened with urine. This soon renews the fermentation; and as soon as the heap begins to heat, it is spread out, and the manure is immediately ploughed under.

When the supply from the yard and from the vaulted cistern, together with what can be purchased, is not sufficient, recourse is had to the refuse cakes of colza from which the oil has been pressed out. These are dissolved in urine or in water, and put into the cistern to decompose. When it is in a proper state, it is used chiefly on the land on which flax is intended to be sown, as it is a very rich manure, and perfectly free from the seeds of noxious weeds.

In the tillage of the land the Flemings use few and very simple instruments. The common plough for light lands is a small light foot-plough, so called from a piece of wood inserted in the beam, which is somewhat in the shape of a foot, or rather of the wooden shoe in common use in Flanders. It has no wheels, and is drawn by one or two horses. It is the parent of the Rotherham plough, from which most of the improved ploughs for light soils are derived. It is the most perfect plough for light sands, acting like a shovel at the fore part of the turn-furrow, which is concave, and completely turns over the soil. In the stiffer soils the turn-wrest plough is sometimes used, made much smaller and lighter than the heavy Walloon plough. It has two small wheels attached to that part of the beam where a single wheel is sometimes put, by means of a small iron bar, which is connected with the middle of the axle by means of a pin, so that whatever be the inclination of the axle caused by unevenness of ground, or by one of the wheels running in the furrow, this bar always remains upright, and supports the end of the beam. This plough is much steadier than the foot-plough, and better adapted to break up very stiff ground.

An instrument peculiarly Flemish is the *traîneau.* This is a wooden frame of a triangular shape, covered with boards, which is drawn over the ground to smooth the surface and press in the seed. The harrows in common use are also triangular, and made entirely of wood; the pins are driven obliquely and point forwards, so as readily to enter into the ground when the harrows are drawn by the angle. The blunt end of the pins projects about an inch or more on the side from which they are driven in: thus, by reversing the instrument, a slighter degree of harrowing is given, which has an effect intermediate between that of the harrows and the traîneau.

The mollebaert, another Flemish instrument for levelling ground, has been already noticed. The Hainault scythe and hook are generally used for reaping corn. The instrument is held in the right hand, and the hook in the left: by a swing of the arm the corn is cut close to the ground towards that which is standing; the hook collects it and rolls it up into a sheaf, which is taken up by means of the leg and the scythe, and laid down to be tied. It is better than a fagging-hook, and does the work more easily. These are the only instruments in common use which differ at all from those of other countries. None of the more complicated modern inventions have been introduced, nor would they be readily adopted, however ingenious or useful they might be; for an adherence to old established methods, and a repugnance to what is new, are nowhere so firmly rooted as amongst the Flemish peasantry.

The most important instrument in Flemish agriculture is the spade, which is used to a much greater extent than in England, and in some instances is the only instrument of tillage. The trenching spade is made light and long, and is well adapted to the loose sandy soils. The first step to improvement is generally a complete and deep trenching; and in the Waes district a sixth part of the whole farm is trenched every year; and where this is not done, the intervals between the stitches in which the land has been ploughed are dug out with the spade a foot or sixteen inches deep, and the earth thrown evenly over the beds in which the seed has been sown. By shifting these intervals a foot every year, the whole of the land which lies in stitches six feet wide is dug, and the upper and under soil mixed regularly. This process is extremely useful in producing an even crop, especially of flax, the roots of which strike deep.

The rotations adopted in light sands

and loams are various. In the poorest and least improved, buckwheat, rye, and oats are the chief crops, with potatoes and clover, which require more manure. Every crop is manured except buckwheat, which grows well in the poorest soils, and becomes too luxuriant to give much seed in rich and highly manured lands. Bones have not been introduced except by way of experiment; but when their value on light soils shall be more generally known, especially in raising turnips, there is no doubt but they will be extensively used. This may lead to the folding of sheep to eat them on the land, and thus introduce an important improvement into Flemish husbandry.

On the better kinds of light soils, which are not well adapted for wheat, the usual course is—1st, rye, with turnips in the same year after the rye is cut; 2nd, oats; 3rd, buckwheat; 4th, potatoes or carrots; 5th, rye and turnips; 6th, flax; 7th, clover.

When the sand becomes a good light loam, wheat is introduced in the rotation, after potatoes or after clover: the latter is thought the best practice, as the roots of the clover both enrich and consolidate the soil.

Rye recurs more frequently than would be thought prudent if it were not for the turnips sown after it, which seem to correct the effect produced on the soil by the seeding of the rye; so that rye and turnips are sometimes followed by rye, in which clover is sown in the next spring. Thus rye and turnips may alternate in light lands, as beans and wheat sometimes do in rich heavy clays. The turnips are never eaten on the land where they grow, but are always drawn and housed in the end of September, the green tops being cut off and given to the cows and pigs, and the roots stored in dry cellars. The land is then immediately ploughed after some dung has been put on; and if oats are the next crop which are sown in spring, it remains so all winter.

When the land is of a better quality, although still in the class of light loams, wheat recurs more frequently, and the rotation is varied as follows:—rye and turnips, potatoes, wheat, rye and turnips, oats, flax, clover, wheat. If the soil is fit for barley, this grain is substituted for rye. Carrots are frequently sown in the barley, and also in the flax: they strike deep into the rich light earth, but come to no size while the principal crop is on the ground. As soon as this is taken off, the land is harrowed and carefully weeded by hand: liquid manure, diluted if the weather is dry and warm, is spread over the surface, and in a short time the carrots throw out their green tops, and swell in the ground: by the end of September a considerable crop of them may be dug up. The best variety for this purpose is a large white carrot, which rises some inches out of the ground: it has been lately brought into notice in England, and will no doubt soon be more generally cultivated. [CARROT.] There is another variety, which is yellow, and also attains a good size; but it is inferior to the first in good ground. The quantity of roots raised for the winter provision of the cattle is considerable, and forms a very important part of the husbandry of Flanders, where all the cattle are constantly kept in the stables in winter, and, except where there are natural pastures, in the summer also.

Flax is everywhere a most important crop, for it much exceeds all other crops in value. Where it can be raised of a tolerable quality, every other crop has a reference to this; and the rotation is arranged accordingly. There is no country where more attention is paid to flax than in Flanders, especially in the neighbourhood of Courtray. The land is brought into the highest state of richness and cleanness before flax is sown in it; and the most abundant manuring with rape-cake and urine is thought essential to raise this crop in perfection. [FLAX.]

On the heavier loams, colza, or rape [COLE], is an important crop for the seed from which the oil is expressed. It is sown in a bed in July or August, and planted out in rows two feet apart in October. The seed ripens early in the next summer, and a good crop of turnips may be had after it. The summers being in general warmer and drier than in England, the Flemish farmer is enabled to thrash out his rape-seed on a cloth in the field soon after the stems have been cut and laid gently on the ground to dry the pods. Any delay in this operation would cause a great loss: with every care and attention, much seed is always scattered in harvesting, because the pods do not ripen equally, and some will have shed their seeds before others are sufficiently ripe to be gathered.

Potatoes were introduced into Flanders from England about the year 1740, and from being at first only cultivated as a rarity, soon became an important part of the food of men and beasts. There is nothing peculiar in the Flemish mode of cultivating this useful root. The sets are planted with a blunt dibble, as is the case in gardens in England: sometimes they are laid in the furrows and covered with the plough: they are always earthed up round the stems, sometimes by a plough with a mould-board on each side, but generally by hand with a broad hoe. The manure usually put on the land in which potatoes are to be set is double the quantity used for a corn crop; and a good soaking of the soil with urine is thought to invigorate the growth of the plant greatly. The produce, however, is not much more abundant than it is usually in those parts of England where potatoes are raised in considerable quantities in the fields—about 300 bushels on an acre. There is a small yellow potato in Flanders, which is excellent when boiled, and which grows well in a stiff loam, but it is not so productive as the large cattle potato.

The cultivation of the sugar beet has been resumed lately, after it had been entirely abandoned. There are now several considerable manufactures of beet-root sugar; but it is not a favourite culture with the farmers, not even for their cattle, as it is too long on the ground. They prefer turnips and carrots, which can be raised on the same land which has borne another valuable crop the same year.

In the heavier loams, which are chiefly to be met with in West Flanders and about Alost, the following rotation is adopted:—flax, clover, barley or oats, beans, wheat, rye and turnips, potatoes, colza and carrots, flax; or flax, colza, wheat, rye and turnips, oats, clover, wheat, rye.

Beans are not a favourite crop, and are not carefully cultivated. They are sometimes sown very thick, mixed with peas and tares, to be cut up in a green state for the cows and pigs; and in this way they produce a great quantity of green food, and clean the ground by excluding the air and smothering the weeds. On a farm of thirty-six bonniers, in a very good loamy soil near Courtray, the land was divided into six equal parts of six bonniers each, and the crops were distributed as follows:—

Clover. Carrots. Potatoes.	Wheat.	Wheat. Beans.
Rye & Turnips.	Flax. Colza.	Oats.

The manure used for these crops was partly dung from the yard and cows' urine, but chiefly the sweepings of the streets and the emptyings of privies from Courtray.

In a very rich loam, not far from Ypres, the following crops were noticed in regular rotation:—1. turnips with chicory and carrots; 2, oats; 3, clover; 4, wheat; 5, flax; 6, wheat; 7, beans; 8, wheat; 9, potatoes; 10, wheat; 11, oats. All these crops are of an exhausting nature, and it requires a very rich soil, aided by abundant manuring, to bear this rotation for any continuance; but each of these crops had a good portion of manure.

Great attention is paid to prepare the land so as to secure a good crop from a small quantity of seed. The seed usually sown in Flanders is about one-third less than in England, even when the seed is drilled, which it never is in Flanders. The ground is rendered mellow and rich by the tillage and the liquid manure; and the seed, which has been carefully selected, is covered by earth spread over it with the spade: it is afterwards rolled or trod in with the feet. Every grain vegetates, and should there be any slowness in the growth, the urine-tank supplies an excellent stimulant. It is in the springing of the blade, after the farina in the seed is exhausted, that the liquid manure seems to produce the greatest effect. When the stem is shot up, it may perhaps too much encourage the increase of green leaves, and thereby hinder the formation of the flower and the seed: experiments made with liquid manure lead to this conclusion.

There are some very rich pastures in Flanders about Furnes and Dixmude, where excellent butter is made. A great many beasts are fed in the summer, and a moderately-sized ox turned out in good condition in April or May will fatten on an acre of land by August or September. The best cows and oxen are of the Dutch breed; those which are bred in Flanders are inferior. The butter about Dixmude is churned from the cream only, although the most common practice is to churn the whole milk after it has stood some time and begins to be acid. It is always set in shallow pans immediately after milking, and left so twelve hours. The cream is then skimmed off, or the whole milk is poured into deep vessels till it is fit to be churned. The churning is performed in a barrel-churn or a plunge-churn: in either case, in the larger dairies, it is moved by a horse, which turns a wheel connected with the churn.

The breed of horses in Flanders is large and heavy, but deficient in activity and clumsy in form. The mares were once in repute for heavy carriages, but at present an equipage drawn by Flanders mares would be an object of wonder, if not of ridicule. Many horses have been imported into England from Flanders as cart-horses; but they were preferred chiefly on account of the price at which they could be obtained, and of the apparent bulk of them. For active and enduring qualities they are much inferior to our best breeds of English cart-horses.

The Flemish sheep are coarse in the wool, and much inferior in the carcass to the Leicester or South-Down. Some good sheep have been imported, which may much improve the native breeds. The pigs are as badly shaped as can well be imagined,—long in the neck and head, and high on their legs. They are badly fed when young, and fatten slowly, although in time they acquire considerable weight. A better breed has been introduced, which will soon supersede the old.

The farm-buildings are very good and convenient in general. The farms are small, compared with those in other countries; 120 acres is considered a very considerable occupation. In the Waes country, where the spade is extensively used in the cultivation of the land, the farms are very small, fifty acres being amongst the largest, and the average is not above fifteen. A farm of this description requires only one horse to cart the manure and plough the land; four or five cows are the usual complement, with two or three pigs. The cows are fed on clover in summer, and on barley or oats cut green; in winter, on potatoes, beetroot, turnips, and carrots, which are chopped up together and boiled in a copper. This is given milk-warm three times a day, and is called brassin; when grains can be procured from the brewers they are added to the mess. The cows never move from their stalls: after having had three or four calves, a cow is generally fattened and sold off; and a young heifer, of which a couple are reared every year, supplies her place.

FLAX (*Linum perenne*) is an annual plant, cultivated from time immemorial for its textile fibres, which are spun into thread and woven into linen cloth. It has a green stem from a foot and a half to two feet high, and a blue flower, which is succeeded by a capsule containing ten flat oblong seeds of a brown colour, from which an oil is expressed, which is extensively used in manufactures and in painting. There are several varieties of flax cultivated; the best seed comes from Riga and from Holland. As the several varieties do not reach maturity in the same time, and the stems of each variety rise to different heights, it is essential that the seed be not mixed, as this would occasion great inconvenience and loss in the pulling of the flax. There is a very fine long variety which is cultivated in the neighbourhood of Courtray, in Flanders; it requires a very good soil to grow in, and the stem is so long and slender that if it were not supported the least wind would break it and lay it flat, in which case the quality of the flax would be much impaired and the quantity reduced. To prevent this, short stakes are driven into the ground in a line at eight or ten feet from each other, and long slender rods are tied to them with oziers about a foot or eighteen inches from the ground, forming a slight railing to support the flax: a number of these are placed in the same manner at a short distance from each other in parallel lines, all over the field, and the flax is thus prevented from being beat down. A better method, which is not commonly adopted, is to have stakes in regular rows, and thin ropes tied to them, instead of rods: by having these lengthwise and others across them at right angles, a kind of large net is spread over the whole field, and none of the flax can possibly be laid flat. By using cheap rope or strong tar-twine from old cables, the expense is not very great, and much less room is taken up than by the rods. When the flax is pulled, the stakes are taken up, and removed to a dry place till they are wanted again.

The most common variety of flax is of a moderate length, with a stronger stem: if it is not sown very thick it will throw out branches at top and produce much seed: it is therefore a matter of calculation whether it will be most profitable to have finer flax with less seed, or an inferior quality with an abundance of seed.

There is a small variety which does not rise above a foot, grows fast, and ripens its seed sooner. When linseed is the principal object, this variety is preferred; but the flax is shorter and also coarser.

Another variety of flax has a perennial root, and shoots out stems to a considerable height. It came originally from Siberia, and was much recommended at one time, but its cultivation did not spread. If it were sown in wide rows and kept free from weeds by hoeing, it might perhaps be profitably cultivated for the seed; and if the flax is inferior in quality, it might still be of some value for coarse manufactures; it requires however to be renewed every three or four years and sown in fresh ground.

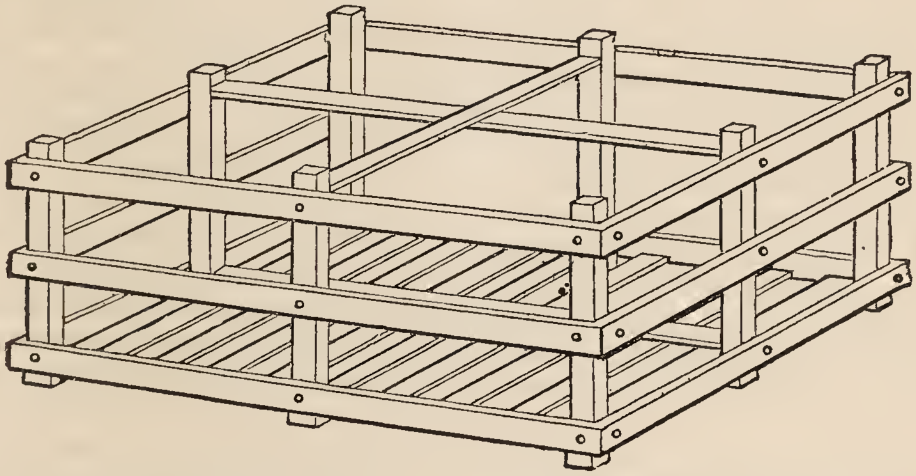
The soil best adapted to the growth of flax is a deep rich loam in which there is much humus, or vegetable mould. It should be mellow and loose to a considerable depth, with a sound bottom, neither too dry nor too moist: either extreme infallibly destroys the flax; it is therefore not suited either to hot gravelly soils or cold wet clays, but any other soil may be so tilled and prepared as to produce good flax. It thrives well in the rich alluvial land of Zealand and the polders, but it is also raised with great success in the light sands of Flanders, but much more careful tillage and manuring are required. The land on which flax is sown must be very free from weeds, the weeding of this crop being a very important part of the expense of cultivation. These circumstances suggest the best mode of preparing the land. A long fallow, such as is sometimes given to the land in Essex, including two winters and a summer, may be a good preparation on the heavier loams, which should be trench-ploughed and worked deep: the manure should be dung fully rotten, or a compost of earth and dung: it should be put on the land in autumn, and well incorporated before the seed is sown. If the land is sufficiently clean, a crop of potatoes well manured may be substituted with advantage for the fallow; but at least double the usual quantity of dung should be given to this crop, that enough may remain in the ground for the flax. Lime may be used if the soil contains a great portion of clay; but in the lighter loams there is some doubt of its advantage for flax. At all events it should not be used immediately before the flax is sown, but for some previous crop. Peat-ashes are excellent; they improve the soil and keep off insects, which are apt to injure the roots of the flax. For want of peat-ashes, those made by the burning of weeds and earth in a smothered fire are a good substitute. But the most effective manure is the sweepings of the streets in towns mixed with the emptying of privies and the cleaning out of the butchers' stalls and shambles. On light soils much manure is required; and where night-soil cannot be obtained in sufficient quantities, rape-cakes, from which the oil has been expressed, dissolved in cows' urine, form the best manure. In many parts of Flanders, 500 rape-cakes are used for every acre of flax, besides the usual quantity of Dutch ashes and of liquid manure, which is the drainings of dunghills and the urine of cattle collected in a cistern and allowed to become putrid.

In southern climates flax is sown before winter, because too great heat would destroy it. It is then pulled before the heat of summer. In northern climates the frost, and especially the alternations of frost and thaw in the early part of spring, would cause the flax to perish; it is consequently sown as early in spring as may be, so as to avoid the effect of hard frost. This is in March or April in Great Britain and Ireland, and in Holland and Flanders. In no country is the ground better prepared for the growth of flax than in Flanders; and it may therefore be interesting to follow the whole process of Flemish cultivation for several crops preparatory to that of flax, which is the most important produce in that country, and that which, when well managed, gives the greatest profit to the farmer. The best flax grows near Courtray. The soil is a good deep loam, rather light than heavy. It is not naturally so rich as the soil of the polders in Flanders and in Zealand, but the tillage and cultivation are far more perfect, and the produce, if not more abundant, is of a finer quality. Every preceding crop has a reference to the flax, and is so cultivated as to improve the texture of the soil, which is abundantly manured in order to leave a considerable surplus in the ground. If the land has not been trenched all over with the spade to the depth of eighteen or twenty inches, it has been equally well stirred by the narrow open drains which are dug out twelve or fifteen inches deep every year between the stitches in which it is laid by the plough. These drains, or water-furrows, are a foot wide, and from a foot to eighteen inches deep. The earth taken out of them is spread evenly over the land after the corn is sown. When the ground is ploughed again, care is taken that the place of these water-furrows shall be shifted a foot on each side. Thus in six years the whole soil is deepened and thoroughly mixed with whatever manure has been put on. This produces the same effect as trenching, and even more perfectly. The whole of the land in which the best flax grows has been so treated for several generations, and may be looked upon as a species of compost eighteen inches deep. Potatoes or colza are usually planted with a double portion of manure, after which wheat is sown, slightly manured; then rye, with turnips sown the same year, after the rye. These are taken up in September or October, and stored for winter use. The land has been well weeded while the turnips were growing, and all the manure is decomposed and mixed with the soil. It is ploughed in stitches before winter, some manure having been previously spread over it if necessary; and it is left exposed to the mellowing effects of frost and snow. As soon as the winter is over and the snow is melted, the final preparation goes on. Deep ploughing and harrowing further divide and pulverize it: the surface is laid as level and smooth as possible; and if there is no fear of too much wet, which in this light loam soon disappears, the whole is laid flat and level as a bowling-green, or else divided into beds with water-furrows between them. On this the liquid manure is poured out, and the Dutch ashes spread, if any are used, or the rape-cakes, as mentioned before. The harrows are drawn over the land, and it is left so a few days that the manure may sink in. It is then again harrowed, and the linseed is sown broadcast by hand, very thick, and even about one hundredweight and a half to the acre. A bush-harrow or a hurdle is drawn over, merely to cover the seed, which would not vegetate if it were buried half an inch deep. According to the state of the land it is rolled or not, or the seed is trodden in by men, as is done with fine seeds in gardens. This is only in the lightest soils. Most commonly the traîneau is drawn over the land. This is a wooden frame with boards nailed closely over it, which is drawn flat over the ground to level and gently press it. In a short time the plants of flax come up thick and evenly, and with them also some weeds. As soon as the flax is a few inches high, the weeds are carefully taken out by women and children, who do this work on their hands and knees, both to see the weeds better and not to hurt the flax with their feet. They tie coarse pieces of cloth round their knees, and creep on with their face to the wind, if possible. This is done that the tender flax, which has been bent down by creeping over it, may be assisted by the wind in rising. This shows what minute circumstances are attended to by this industrious people. The weeding is repeated till the flax is too high to allow of it.

The seed which is used is generally obtained from Riga, it being found that the flax raised from home-grown seed is inferior after the first year. But many intelligent men maintain that if a piece of ground were sown thin with linseed, so that the flax could rise with a strong stem, and branch out, and if the seed were allowed to ripen, the Flemish seed would be as good as that from Riga; but it still remains to be proved whether it would be cheaper to raise it or to import it.

When the flax begins to get yellow at the bottom of the stem, it is time to pull it, if very fine flax is desired, such as is made into thread for lace or fine cambric; but then the seed will be of little or no value. It is therefore generally left standing until the capsules which contain the seed are fully grown and the seed formed. Every flax-grower judges for himself what is most profitable on the whole. The pulling then begins, which is done carefully by small handfuls at a time. These are laid upon the ground to dry, two and two obliquely across each other. Fine weather is essential to this part of the operation. Soon after this they are collected in larger bundles and placed with the root end on the ground, the bundles being slightly tied near the seed end; the other end is spread out that the air may have access, and the rain may not damage the flax. When sufficiently dry they are tied more firmly in the middle, and stacked in long narrow stacks on the ground. These stacks are built as wide as the bundles are long, and about eight or nine feet high. The length depends on the crop; they are seldom made above twenty or thirty feet long. If the field is extensive, several of these stacks are formed at regular distances; they are carefully thatched at top; and the ends, which are quite perpendicular, are kept up by means of two strong poles driven perpendicularly into the ground. These stacks look from a distance like short mud walls, such as are seen in Devonshire. This is the method adopted by those who defer the steeping till another season. Some carry the flax as soon as it is dry under a shed, and take off the capsules with the seed by *rippling*, which is drawing the flax through an iron comb fixed in a block of wood: the capsules, which are too large to pass between the teeth of the comb, are thus broken off and fall into a basket or cloth below. Sometimes, if the capsules are brittle, the seed is beaten out by means of a flat wooden bat, like a small cricket-bat. The bundles are held by the root end, and the other end is laid on a board and turned round with the left hand, while the right hand with the bat breaks the capsules, and the linseed falls on a cloth below. The flax is then immediately steeped: but the most experienced flax-steepers defer this operation till the next season. In this case it is put in barns, and the seed is beat out at leisure in winter. When flax is housed, care must be taken that it be thoroughly dry; and if the seed is left on, which is an advantage to it, mice must be guarded against, for they are very fond of linseed, and would soon take away a good share of the profits by their depredations.

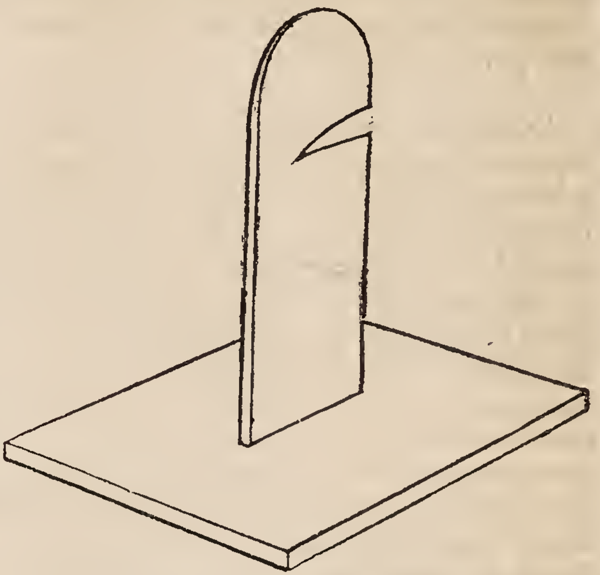
Steeping the flax is a very important process, which requires experience and skill to do it properly. The quality and colour of the flax depend much on the mode of steeping; and the strength of the fibre may be injured by an injudicious mode of performing this operation. The object of steeping is to separate the bark from the woody part of the stem, by dissolving a glutinous matter which causes it to adhere, and also destroying some minute vessels which are interwoven with the longitudinal fibres, and keep them together in a kind of web. A certain fermentation or incipient putrefaction is excited by the steeping, which must be carefully watched, and stopped at the right time. The usual mode of steeping is to place the bundles of flax horizontally in shallow pools or ditches of stagnant water, keeping them under water by means of poles or boards with stones or weights laid upon them. Water nearly putrid was supposed the most efficacious, and the mud was often laid over the flax to accelerate the decomposition: but this has been found to stain the flax, so that it was very difficult to bleach it or the linen made from it afterwards. The method adopted by the steepers of Courtray, where steeping flax is a distinct trade, is different. The bundles of flax are placed alternately with the seed end of the one to the root end of the other, the latter projecting a few inches: as many of these are tied together near both ends as form a thick bundle about a foot in diameter. A frame made of oak-rails nailed to strong upright pieces in the form of a box 10 feet square and 4 deep, is filled with these bundles set upright and closely packed. The whole is then immersed in the river, boards loaded with stones being placed upon the flax till the whole is sunk a little under the surface of the water. The bottom does not reach the ground, so that the water flows over and under it. There are posts driven in the river to keep the box in its place, and each steeper has a certain portion of the bank, which is a valuable property. The flax takes somewhat longer time in steeping in this manner than it does in stagnant and putrid water, and it is asserted by those who adhere to the old method that the flax loses more weight; but the colour is so much finer, that flax is sent to be steeped in the Lys from every part of Flanders. When it is supposed that the flax is nearly steeped sufficiently, which depends on the temperature of the air, the flax being sooner steeped in warm weather than in cold, it is examined carefully every day, and towards the latter part of the time several times in the day in order to ascertain whether the fibres readily separate from the wood the whole length of the stem. As soon as this is the case the flax is taken out of the water: even a few hours more or less steeping than is necessary will make a difference in the value of the flax. If it is not steeped enough, it will not be easily scutched, and the wood will adhere to it. If has been too long in the water, its strength is diminished, and more of it breaks into tow. The bundles are now untied, and the flax is spread evenly in rows slightly over-lapping each other on a piece of clean smooth grass which has been mown or fed off close. Fine weather is essential to this part of the process, as rain would now much injure the flax. It is occasionally turned over, which is done dexterously by pushing a long slender rod under the rows and taking up the flax near the end which overlaps the next row and turning it



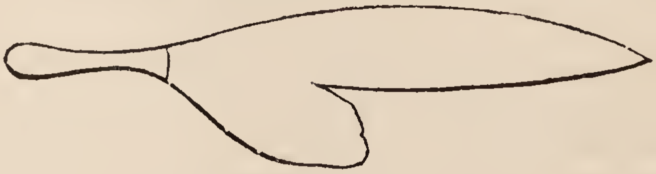
Frame in which the flax is packed to be steeped in the river Lys in Flanders.

quite over. Thus, when it is all turned, it overlaps as before, but in the contrary direction. It remains spread out upon the grass for a fortnight, more or less according to the season, till the woody part becomes brittle and some of the finest fibres separate from it of their own accord. It is then taken up, and as soon as it is quite dry it is tied up again in bundles, and carried into the barn to be broken and heckled at leisure during the winter.

In the domestic manufactures the flax is broken or scutched at home, when the weather prevents out-door work. The common brake consists of four wooden swords fixed in a frame, and another frame with three swords, which play in the interstices of the first by means of a joint at one end. The flax is taken in the left hand and placed between the two frames, and the upper frame is pushed down briskly upon it. It breaks the flax in four places, and by moving the left hand and rapidly repeating the strokes with the right, the whole handful is soon broken. It is then scutched by means of a board set upright in a block of wood so as to stand steady, in which is a horizontal slit about three feet from the ground, the edge of which is thin. The broken flax held in handfuls in the left hand is inserted in this slit, so as to project to the right, and a flat wooden sword of a peculiar shape is held in the right hand; with this the flax is repeatedly struck close to the upright board, while the part which lies in the slit is continually changed by a motion of the left hand. This operation beats off all the pieces of the wood which still adhere to the fibre, without breaking it, and after a short time the flax is cleared of it and fit to be heckled. But the operations of breaking and scutching are tedious and laborious when thus executed by hand. A mill is now used (where large quantities of flax are required for manufactures), having three fluted cylinders, one of which is made to revolve by horse or water power, and carries the other two round. The flax plants are passed between these cylinders while thus revolving, and the stalk, or *boon*, as it is technically called, is by this means completely broken without injuring the fibres. The scutching is accomplished in the same mill by means of four arms projecting from a horizontal axle, arranged so as to strike the boon in a slanting direction until the bark and other useless parts of the plant are beaten away. In the last process by which flax is prepared for the spinner, the *heckling*, the instrument employed, called the heckle, is a square piece of wood studded with rows of iron teeth about four inches long and disposed in a quincunx order. The fineness of the heckle is chosen with reference to the quality of the flax, and heckles differing in this respect from each other are used at different stages of the dressing, the coarsest first, and the finest to give the last degree of smoothness and finish to the flax. The operation of heckling is performed by the workman



Upright board to clear the flax of the wood.



Flat sword or scutcher.

grasping a handful of flax by the middle, and drawing first one side or end and then the other through the teeth of the heckle, until every particle of extraneous matter is removed, and the whole of the filaments are arranged in distinct, even, and parallel fibres.

FOREST SCIENCE constitutes a separate and distinct branch of education, which originated in Germany from the increased scarcity of wood. The first special instruction of this kind was given by Mr. Zanthier at Ilsenburg, near the Harz forest, and its importance being immediately appreciated, forest academies soon multiplied, particularly in the central parts of the country. Prussia directed particular attention to the subject, and the late king, on coming to the throne, ordered that, 'in future, situations in the forest department should be conferred with a view to the most perfect preservation of the forests; that the nominations should be founded on knowledge and experience, and no longer granted as a recompense for service.' In consequence a new organization took place, and competent instruction in all things appertaining to the management of forests became a necessary qualification for an appointment to any post in the forest department.

In the forest academies are taught botany generally, and particularly as regards the ordinary productions of the forest, including vegetable physiology, mineralogy, zoology, chemistry, surveying, mensuration, mechanics, the methods of resisting the encroachments of sands, draining and embanking, together with the care and chase of game; as also the laws and regulations of forest administration. The examination which the candidates undergo is very strict, and the result of the system has been eminently beneficial.

France has also a particular administration of the forests, and a very detailed code of forest laws. Russia, from the immense extent of its forests, is under little apprehension of a scarcity of wood, nevertheless the consumption of this article is so enormous, all the houses of the peasantry being built of it, and no other fuel being used, that it has been deemed advisable to pay some attention to the subject, and a board has been formed under the particular sanction of the government for the better preservation of the forests and more general instruction in forest science.

Louis XIV., by an *ordonnance* of 1669, placed the forests under the direction of a separate branch of the government. Men of science then began to turn their attention to this subject. Du Hamel, Du Monceau, and Buffon were among the first naturalists who wrote on the management of forest-trees.

The consideration of the various trees which may be cultivated to advantage, and the uses to which their woods may be put, with the mode of their propagation in various soils, forms a branch of forest science.

The following is a list of the principal forest-trees:—

The oak (Quercus), and its varieties the beech (Fagus sylvatica), the hornbeam (Carpinus betulus), the birch (Betula alba), the elm (Ulmus), the maple (Acer campestre), the alder (Betula alnus), the ash (Fraxinus excelsior), the lime (Tilia sylvestris), the chestnut (Fagus castanea), the walnut (Juglans regia), the crab (Pyrus malus), the wild cherry (Prunus avium), the mountain service (Sorbus aucuparia), the service (Sorbus domestica), the aspen (Populus tremula), the white poplar (Populus alba), the common poplar (Populus nigra), the Lombardy poplar (Populus fastigiata), the sycamore (Acer pseudo-platanus), the plane (Platanus orientalis), the hazel (Corylus sylvestris), the sallow (Salix capræa), the osier (Salix viminalis), the pine (Pinus sylvestris), the silver fir (Pinus picea), the larch (Larix Europea). The wood of all those trees is divided into three sorts: hard wood, white wood, resinous wood. The German writers admit only two sorts of trees, the deciduous and evergreen, but this is more a botanical division than one applicable to forest-trees.

The uses to which the wood is applied vary much, according to circumstances and situations. The most profitable is that of timber for buildings, and more particularly for naval architecture. The oak, beech, elm, and fir are the chief woods employed for this purpose; but the chestnut was at one time considered as equal to the oak, as the roofs and beams of many old buildings testify; Windsor Castle among the rest. For millwrights the ash, beech, service-tree, walnut, and crab are most useful. For various utensils for the dairy and domestic use, the sycamore, the lime, and the poplar are used on account of the whiteness of their wood. Various soft woods are used for turning, as well as the hardest, when they have a close grain and are not apt to split.

When wood cannot be applied to building or domestic uses, it is still very valuable as fuel, and in this point of view it is important in those countries where pit coal is not abundant. The best wood for fuel is oak, and next to this beech. The harder the wood, in general, the more heat it gives out in burning. The trunks of large trees, sawn into convenient lengths and then split into billets, make the best fuel; but where wood is scarce it is found most profitable to cut down the trees at the age of 30 or 40 years at most, when they have acquired a considerable height of stem, but no great girth. In the woods which are planted for this purpose in France and Germany the trees are drawn up by being left close together, and the side branches are kept cut to the height of 30 or 40 feet, so that they only spread out at top, and the trunk never acquires the size which it would if the tree stood singly, and had room to spread out its branches.

In order to judge of the value of woods in different soils the following table may be useful. It is calculated on the supposition that the ground is covered with trees as much as it will bear.

The cord here alluded to is 5 feet 6 inches in height, 8 feet long, and 3 feet 6 inches wide, French measure, that is, very nearly 6 feet high, 8 feet 8 inches long, and 3 feet 10 inches wide, or 200 cubic feet English measure.

In the following table the tops made into charcoal and the faggots are reduced to cords in the proportion of four and a half cords of charcoal-wood and 550 faggots for one cord of fire-wood.

Produce of Fire-wood per acre, at different ages, in cords.

Age of Trees. Years.	On Poor Soils.	Middling Soils.	Good Soils.
10	2	3½	4½
15	2¼	5¾	9
20	3¾	9¼	15
25	5¼	13¼	21
30	6½	16¾	27
35	7	21	35
40	7	24½	42
50	6	31	56
60	5	37½	70
70	3	41½	80
80	2	46	90
90	1	48½	96
100	.	51	102
120	.	57	114
140	.	62	124
150	.	64	128
200	.	67	135
250	.	60	120
300	.	55	110

This table is the result of careful measurement of woods cut down at different ages; and it shows that the maximum in poor soils is attained in thirty-five years, in middling and good soils at 200. But it also shows that the increase of wood per cent. in ten years is greatest from twenty to thirty in poor soils, from forty to fifty in middling soils, and from seventy to eighty in good soils; so that it never can be profitable to allow any wood which is to be used for fuel to stand above eighty years.

In good soil at thirty-five years' growth the wood in the tree has increased one cord per acre each year; and the rate of growth increases till the ninetieth year, after which it begins to diminish. But it must also be taken into the account that wood of the age of seventy, eighty, and ninety years is of far greater specific gravity than that of twenty-five or thirty; and consequently the increase in bulk in ten years, from eighty to ninety, produces more fuel than the mere measure indicates. On good soils oaks and beech will continue to increase for 200 years; but in poor soils they do not thrive after thirty-five years, and then they begin to waste.

Preparatory to making a plantation of any extent it is necessary to establish a nursery to raise plants; for although trees which are raised from seed and have never been moved become much larger and finer than those which are transplanted, it will be found on calculation that a quick return is much more profitable; and as a matter of economy trees which have been raised in a nursery and transplanted arrive sooner at a certain growth than those which are sown on the spot where they are to remain.

The ground chosen for a nursery should not have a better soil than that in which the plants are finally to be placed, because, in that case, they would most likely suffer, if not perish altogether. The surface may be enriched by some manure to make the seed vegetate. If it is small, it may be sown in drills, and the acorns and larger seeds may be dibbled regularly, as beans are in a garden. The ground being kept very free from weeds by hoeing, the plants will rise regularly, and they may be thinned out after the first year; those which are taken out may be transplanted after cutting off the tap-root, in another spot in the nursery. When the trees are three or four years old, and have clean and straight stems, the side branches having been carefully pruned off, they may be transplanted where they are to remain. The ground should be trenched and well drained if it is wet. It is useful in northern climates to plant hardy evergreens, such as the Scotch fir, amongst forest-trees, to serve as shelter to them while they are tender. These are called nurses, and are gradually cut out as the oaks, ash, beech, and other more valuable trees grow up. If the ground is dry, it is only necessary to dig a hole eighteen inches deep and a yard in diameter, for each tree; this is to be half filled up with the loose earth taken out; the young tree is then to be placed on this surface and its roots spread out, the tap-root being cut off. The best earth is then carefully spread over the roots and trod in with the feet, and the whole filled up to the level of the ground. In wet situations the trees are sometimes placed nearly on the surface of the ground, and a small mound of earth is raised round the stem; but it is much better to drain the land properly, without which the plantations will never thrive. The proper distance to plant oaks is ten feet apart each way, with a fir-tree between every two. In five years half of the firs may be cut out and the oaks pruned where it is necessary. In fifteen years all the firs will be cut out, and the oaks will be able to protect one another. In twenty-five years from transplanting, half of the trees may be cut down, and the remainder thinned out gradually as they spread and advance in growth.

In England, where crooked pieces of large oaks are of value in ship-building, the side branches are not taken off higher than fifteen or twenty feet from the ground; and where trees have plenty of room, as in hedge-rows or parks, this may be judicious, but in close plantations it is of advantage to have a long stem without branches: in France and Germany the branches are always cut off to the height of thirty or forty feet. This is done gradually as the tree grows. When the branch is very young it may be cut close to the tree, and the bark will soon cover the wood and obliterate the scar. When they are larger, it is best to shorten them to a few inches from the stem the first year, and cut them close the next: when a branch is cut close in a young tree, no portion of it must project beyond the wood of the stem, and if a portion of the bark of the latter is cut to make all smooth, it will be no detriment, and the wound will soon heal over, provided it is done at the proper time. But if a large branch is cut so that the bark cannot grow over the wound in one year, there is great danger of causing a fault in the wood by the decay of the heart of the branch; in that case it is better to cut it at some distance from the trunk, and to shorten it repeatedly till the branch dies naturally and breaks off. In that case no flaw will be found in the wood. This is the operation of nature in a close wood, which we should endeavour to imitate.

FRANCE, AGRICULTURE OF.—France has always been considered one of the most agricultural countries in Europe; and if the husbandry of France is not superior to that of other countries, it is not for want of writings on this important subject: the French authors on agriculture have collected all the information which has been handed down from the antients, or which experience has taught the moderns. But this has had little influence on the practice of the great mass of the cultivators of the soil, who are too ignorant to read books, and who, if they could read them, would seldom adopt methods not sanctioned by the usage of their forefathers. The want of ready communication by roads and canals must ever prevent any great exertions being made to increase the produce of the soil, beyond the immediate demand of the neighbourhood. One part of France has often had a deficiency of corn approaching to a famine when there was plenty in another. As late as 1837 the price of grain in the south of France varied so much from that in the north, that there was a difference in the duty paid on the importation of foreign corn in different ports; whereas in Great Britain the price is at all times so nearly at a level everywhere, that the only difference arises from the expense of carriage by water, which is always inconsiderable.

In traversing France from north to south, and from east to west, the traveller, who expects to find an improved state of agriculture, is much disappointed. Arthur Young, in his tour through France in 1787, was surprised to find the state of cultivation so low in every province, except those bordering on the Netherlands. His observations have been acknowledged to be just by the French agricultural writers themselves, and a certain spirit of improvement has been excited by his remarks. Since the Revolution in 1793, every encouragement to agriculture has been held out by the government; but notwithstanding the numerous excellent publications which have been produced, and the establishment of agricultural schools and model farms, the progress towards a more general adoption of improved methods of cultivation is very slow. In most parts of France the farmer still resides in or near the village, and the land which he cultivates is dispersed over a considerable extent of distant uninclosed fields. He loses much time in going and returning, and he has a great way to carry the little manure which he makes. Although the use of manure is fully appreciated, there is little knowledge of the means by which it may be increased. Artificial grasses are cultivated to a considerable extent, especially in the southern provinces, but not sufficiently to maintain as much stock as would produce the requisite quantity of manure; and the very small demand for animal food, at a distance from the large towns, gives little encouragement to the feeding and fattening of cattle, except where natural meadows abound, which is only along the course of the rivers, and in the provinces of Normandy and Brittany.

The great division of property which arises from the law of equal distribution among all the children at the death of the parent, tends much to lessen the size of farms. In a country where there are domestic manufactures to give employment to the labourer or peasant, when his plot of ground does not require all his time, a more careful cultivation is the consequence of small occupations. Habits of constant employment excite industry; and the ingenuity is sharpened by the practice of the mechanical arts. But in an ignorant peasant leisure produces idleness; and if a mere sufficiency of food can be procured from a small possession, for which no rent is paid, it is seldom that a great surplus is raised.

The proportion of the population of France which is occupied in agriculture is much greater than in those countries which are chiefly engaged in manufactures and commerce; and yet the inhabitants of the latter are in general better fed, not in consequence of the importation of grain, but of a better cultivation of the soil, as is the case in Belgium. If Holland imports much corn, it exports in return butter, cheese, and cattle. Great Britain and Ireland have required little assistance from foreign countries of late years, although the population has greatly increased.

There are in France very few large proprietors of land who, like the English country gentlemen, spend a great part of their time in the country, and take an interest in agricultural pursuits. There are not many speculative farmers who have capital, and are possessed of a superior practical as well as a theoretical knowledge of agriculture, and who make it a means of acquiring wealth. Few expensive instruments can consequently ever be tried, or brought into general use, nor any extensive improvements undertaken. All these causes concur in preventing a rapid improvement in French agriculture.

The northern part of France, on the confines of Belgium, and in the immediate neighbourhood of Paris, are the best cultivated. In most other parts, except where the maize is cultivated, the old system of two or three crops of corn, and a fallow, is generally adopted. If the fallows were well worked and clean, the crops would be better; but this is by no means the case. The variegated appearance of the corn in May, from the abundant blossoms of weeds, proves that they have not been extirpated. When they appear likely to choke the corn, they are sometimes weeded out; but as the method of sowing the seed in rows or drills with an instrument is unknown or undervalued, there is no possibility of hoeing the intervals between the growing plants, and all the weeding must be effected with the hand.

The best account we have in English of the state of French agriculture is contained in the journal published by Arthur Young, of his journeys through France in 1786-7-8; and although some improvements have been introduced since the Revolution of 1793, and several Englishmen have purchased farms in various parts of France, where they have introduced a better husbandry, the present state is not very different from what Arthur Young represents it to have been half a century ago. He very properly divides the whole of France into four distinct climates as regards agriculture. In the northern the vine does not thrive so much as to make good wine. This district lies north-west of a line which passes near Paris, and is parallel to the line of the French coast on the Channel; that is, in a direction nearly east-north-east and west-south-west, so that it advances more to the north on the eastern part, and less so on the western. The next division is that in which wine is made, but the maize or Indian corn does not thrive. The boundary of this district to the south is nearly parallel to the line first mentioned, and passing through Nancy in Lorraine divides France nearly into two equal parts. The third division is that in which both maize and wine abound, but where the climate is still too severe for the olive or the white mulberry; this is bounded on the south-east by the Jura and a line passing to the north of Lyon. The last division consists of the southern provinces from the last-mentioned line to the Pyrenees, where the olive and the mulberry abound, as well as maize and the vine. In this part the year often yields two harvests of corn, but the soil is not well adapted to permanent pastures, except at a considerable elevation above the sea.

The finest climate is in the third division, where corn, maize, and wine are good and abundant. The heat is not so oppressive as in the southern provinces; and there is the greatest scope for agricultural operations. The most fertile lands are towards the north and east. The Beauce, immediately south of Paris, is a fine country, and so are Touraine, Alsace, and the plain of the Garonne. The worst soils are in Champagne, Sologne, and along the coast of the Bay of Biscay. Arthur Young gives the following distribution of the land and its productions:—The whole surface of France he takes at 131 millions of acres, of which 70 are arable, 5 are taken up by vineyards, 20 covered with wood, 4 in meadows and good pastures, 5 in artificial grasses (which may be added to the arable part), and 27 in wastes, heaths, and poor pastures. These quantities were only an approximation; but they serve to show the small proportion of permanent grass land in France, the greater part of which is in Normandie and Bretagne.

The arable land of France is now estimated at 23,000,000 of hectares, which (taking the hectare = 2·47 acres nearly) are about equal to 56,810,000 acres English measure. The yearly agricultural produce of France is given by Malte Brun as follows:—

	Hectolitres		Quarters.
Wheat	60,500,000	= about	20,800,000
Rye	37,000,000	,,	12,700,000
Maslin, or mixed corn	30,300,000	,,	10,400,000
Maize	6,300,000	,,	2,160,000
Buck-wheat	8,400,000	,,	2,900,000
Oats	32,000,000	,,	11,000,000
Potatoes	20,000,000	,,	6,200,000

We have given the equivalent quantities in English measures in round numbers (taking the quarter = 2·91 hectolitres nearly).

The quantity of grain produced in France now, very little exceeds what was grown fifty years since, although the population has advanced in the interval from 25,000,000 to 32,000,000. The cultivation of the vine, of the artificial grasses, of pulse, and, above all, of potatoes, has however much increased. Beetroot is extensively grown for the manufacture of sugar. The esculent roots and table vegetables are common. Flax and hemp are cultivated in various parts of the country, and to a considerable extent; the hop, tobacco, and madder, in a small degree; and the colza and rape, for oil, is grown in the north. The industry of the peasants in some of the more sterile districts is very great: in the Cévennes and in Auvergne they build walls to retain the alluvial soil brought down by the mountain-streams, and cultivate the sides of the mountains by means of the terraces thus formed.

In the south the soil of the hills is stony, which suits the vine, but is unfit for the growth of corn; between the hills there are valleys which abound in every kind of produce; and where there is a command of water to irrigate the fields, the most productive water-meadows may be made. But there are many spots quite unproductive for want of improvement. Wherever maize is cultivated, it is sown every second year alternately with wheat. This succession cannot fail to exhaust the soil, however good it may have been at first; for maize returns little to the ground in the way of manure, and the straw of the wheat is not sufficient for that purpose. The French-bean is likewise cultivated for its seeds, which, when boiled, are said to contain more nutritive matter than any other seed, in the same compass. These crops cannot be raised to any extent without much manure; and the number of cattle kept is not sufficient to produce an adequate supply of it. The arable land and pastures are not intermixed as in England, but generally lie wide of each other. The horses and cows are fed chiefly on clover, lucern, sainfoin, and other artificial grasses, of which no greater extent is raised than is absolutely necessary. The keeping of more beasts than are immediately required to cultivate the land, for the sake of their manure, is a thing of which the generality of French peasants have no idea, at least in the central part of France. The consequence appears in the average produce of land which has every advantage of soil and climate. The increase of five or six measures of wheat for each measure sown is the full average of production: of barley and oats it may be somewhat more. The mode of valuing a crop by a comparison with the quantity sown is very fallacious: the produce per acre is a better criterion of the goodness of the soil, or the skill of the husbandman. Wherever agriculture is imperfect, more seed is sown than would be necessary with better tillage and manuring. In France the produce of an acre of wheat on good land may be averaged at 15 to 20 bushels, of barley 20 to 25, and of oats 25 to 30, or about one-third less than on similar lands in England, and not much more than half the produce of good land in Scotland, where the climate is much inferior. This is owing to the imperfect manner in which the land is usually worked, cleaned, and manured, and particularly to the deficiency of cattle. In the northern districts of France, where they have the example of Flemish industry, a better system is adopted: but it is astonishing to see the rapid decrease of good cultivation in travelling from Lille to Paris, and still more from Paris to Dijon and the Jura.

The agricultural implements in use in France are few, and not of an improved kind. Each province has its own fashion in making ploughs, most of which are rude and do their work imperfectly. A plough, called a *binot*, with a double mouldboard, is used in several districts, and is useful in stirring fallows; but when no other plough is used, the whole soil is not moved, but the land is merely scored, and the roots of perennial weeds are not destroyed. The heavy turn-wrest plough is used in other districts, chiefly in the northern part, and in heavy soils. The hack, or heavy hoe, is very generally used in those provinces where maize is cultivated: the ground is ploughed in rough ridges, and pulverized by means of the hack: both men and women labour with this instrument; they go in rows, each taking a furrow, and digging up the earth turned over by the plough, reduce it to a proper degree of fineness. If this were well done, and the plough had gone deep, it would be an excellent cultivation, but the soil is only stirred four or five inches deep, and the weeds are not exterminated. Instead of harrows, they use a board called a *traineau,* on which a man stands, while it is drawn over the land by a horse or ox: this levels the surface and covers the seed. The corn is reaped with the sickle, chiefly by women. In the northern parts the barns are very large, to hold the whole crop of the farm; for stacking corn, or even hay, is almost unknown. In the south the corn is thrashed out in the field, and put into granaries immediately after harvest. The size of farms in France is much less than the average of English farms; and the multitude of small occupations, by which a family is barely enabled to exist, is astonishing.

Model farms and establishments for the diffusion of agricultural knowledge have been established in various parts of France. That of Roville, under M. de Dombasle, has been long celebrated by the publication of the 'Annales de Roville.' At Grignon, near Paris, is an agricultural establishment supported by the government; and in several of the provinces similar establishments have been founded of late years. They cannot fail gradually to introduce improved methods of cultivation, and to bring France to its proper place amongst agricultural nations.

The vine is one of the most important objects of cultivation in France. In 10 of the 86 departments it is not grown for the purpose of making wine, or at all upon a considerable scale; in the other departments it is more or less an object of attention. The amount of land occupied by this culture is estimated at rather more than 2,000,000 of hectares, or 5,000,000 of English acres. The average yearly produce of the French vineyards is estimated at 42,000,000 hectolitres (about 924,000,000 gallons), of which about one-sixth is converted into brandy. The former provinces of Champagne, Bourgogne (Burgundy), Lyonnois, Dauphiné, and the Bordelais, from which last district the clarets come, produce the finest growths. The banks of the Charente and the neighbouring districts produce the best (viz., the Cognac) brandy. The wines of Languedoc, Provence, and Roussillon are remarkable for fulness of body; but they want the fine odour (bouquet) of the first class of wines. The annual produce of the vineyards is estimated at 720,000,000 of francs, or about 28,500,000*l.*: of this quantity the exports amount to about 65,000,000 francs, or 2,700,000*l.* The rest is consumed in the country. In the departments of the north and north-west, which do not produce the vine, cider forms the usual drink of the poorer classes.

Of the fruits which are cultivated on a considerable scale in France, the mulberry is one of the most important: it is reared for the nourishment of the silkworm. This branch of culture has much increased of late years. The olive, the orange, the lemon, the pistachio, are grown along the shore of the Mediterranean, but are not equal to those of other lands: the plum when dried furnishes a considerable article of export. The apple and the pear are grown in Normandie and Bretagne for making cider and perry, which furnish the peasantry with their common drink: the apple is also exported in a dried state. The chestnut furnishes the peasantry of the more barren districts with an important article of food, and the walnut is grown for the oil which is expressed from the fruit.

Of forest-trees France has the oak, the cork-tree (*quercus suber*), which is cultivated in the departments of the south-west, the elm, the ash, the beach, the birch, the poplar (white and black), the larch, the juniper, the wild cherry, and the pine. The box, the cornel, the maple, and others furnish the cabinet-maker with ornamental wood. The eastern part of central France is the best wooded district, and the former province of Bretagne is the most destitute of wood. As in France wood is almost universally used for fuel, it is an object of considerable attention; and it is calculated that about one-seventh of the whole country is occupied as wood-land. The principal forests are on the various mountain ranges: except on the Alps and Pyrenees, which are rather bare of wood. The ranges of the Jura and the Vosges furnish good deals, which are often substituted for those of the northern countries of Europe; and the forests of the maritime pine enable the peasants of the Landes, or heaths between the Garonne and the Adour, to turn that else barren tract to some account: these forests yield charcoal, rosin, and pitch.

GARDEN HUSBANDRY is a branch of Horticulture, the object of which is to raise fruits, vegetables, and seeds for profit on a smaller extent of ground than is usually occupied for the purpose of Agriculture.

The best examples of this kind of industry are found among the market-gardeners near populous towns, particularly London, Paris, and Amsterdam. By the application of much manual labour and an abundant supply of manure, they accelerate the growth of vegetables and produce them more abundantly than where manure is not so easily obtained, or where there is not so large a demand for the produce.

The gardeners near Paris, some of whom have gardens within the outer walls of the city, are called *Maraichers*, from the situation of their gardens in a low district which was formerly a marsh (*marais*). The industry of this laborious class is proverbial. Their whole life is devoted to their gardens. They work the whole day in the greatest heat of the sun, and long before the rest of the inhabitants awake they are on their way to the market with their produce. The soil in which they raise their vegetables is naturally a poor sand, but by constant manuring it has been converted into a very rich mould abounding in humus. From its porous nature, and the frequent recurrence of dry summers, it would produce little without constant and abundant watering. The raising of water from numerous wells dispersed through the grounds, and conveying it to the growing plants, is the most laborious part of the work: during the whole summer this labour incessant. There are large stone cisterns is in which the water is allowed to remain, that it may acquire the temperature of the air; and from these it is carried by pipes into various channels which intersect the garden in every direction. These gardeners divide the season into three periods. The first begins in October, when they sow lettuces in a hotbed, which are pricked out a month after, and planted finally in a sheltered border about the end of January, the ground having been well dug and abundantly manured with very rotten dung taken from the hotbeds. At the same time they sow radishes and leeks among the lettuces. The radishes are sold by the end of March, the lettuces in May, and the leeks in June. This completes the first season. The ground is now dug again, and manured with fresh long stable-dung mixed with the earth of which the hotbeds were formed; in this they plant alternate rows of endive or scarolles (both varieties of chicory), and of cucumbers, which produce gherkins for pickling and sauces. The endive is sold in July, and the small cucumbers continue to be gathered till September. In the third season, which is the shortest, another digging and dunging is given, after which they sow radishes and small winter-salad, of which the French have a great variety. Winter endive is also planted for blanching. From this statement it appears that the ground produces a constant succession of culinary vegetables, and that it is manured thrice in the year. The great object is to have a rapid succession, and to allow no plant to occupy the ground long. Cabbages, cauliflowers, asparagus, artichokes, and other vegetables which remain a long time on the ground, are cultivated at a greater distance from Paris, where the land lets at a lower rate. These plants will bear to be carried to a greater distance than the delicate vegetables which are used chiefly in a raw state as salads. The only perennial plant in the gardens of the Maraichers is sorrel, of which there is a great consumption. This is continually dunged and watered to accelerate its growth, and is cut many times in the season. It must however be allowed that this forcing with manure and water, although it produces large and delicate fibres, does not give the flavour which belongs to vegetables grown in common earth, and which have had a more natural growth.

The market-gardens near London are on a larger scale, and if they produce fewer salads and pot-herbs, they produce better and more substantial vegetables, and likewise a considerable quantity of fruit. Mr. Middleton, in his 'View of the Agriculture of Middlesex' (London, 1813), gives an account of the management and produce of the gardens near London, which chiefly supply Covent Garden market.

The best soil is a moist alluvial loam deposited from repeated overflowings of the Thames, which are now prevented by banks or dykes. But an increased demand for vegetables has caused much inferior soils to be cultivated as gardens, and increased labour and manure have supplied the deficiency in natural fertility. The gardeners' year properly begins in autumn, when the land is dug, or rather trenched, and well manured. Various vegetables which will be required in winter are now sown, and especially those which are to produce plants to be set out in spring; spinach, onions, radishes, and winter salads are sown, and when the weather is severe, are protected by a slight covering of straw or mats. In February, the cauliflowers which have been raised in frames or under hand-glasses are planted out. The cabbage plants are pricked out. The radishes, onions, and salads go to market as soon as they are of sufficient size, and sugar-loaf cabbages succeed them. As the cauliflowers are taken off, they are succeeded by endive and celery, and the same is the case with the cabbages. Thus there is a constant succession of vegetables, without one moment's respite to the ground, which, in consequence of continual stirring and manuring, maintains its productive power. Deep trenching in some degree prevents that peculiar deterioration of the soil which would be the consequence of the frequent repetition of similar plants. This effect is most perceptible when the plants perfect their seed, which is seldom or never allowed to take place in market gardens; but great attention is paid to the species of plants which succeed each other on the same spot. The principle which experience and theory unite in establishing, is that of avoiding the too frequent recurrence of plants which belong to the same natural families. The greater variety cultivated in gardens, in comparison with the common produce on a farm, enables this principle to be fully acted upon. Those gardeners who overlook this, and repeatedly sow or plant the same kind of vegetables in the same spots, are soon aware of their error by the diminution of the produce, both in quantity and quality, and by various diseases which attack the plants, however abundant may be the food supplied to them, or careful the tillage.

The principle on which the gardens are cultivated, is that of forcing vegetation by means of an abundant supply of dung, constant tillage, and occasional watering. The whole surface is converted into a species of hotbed; and crop succeeds crop with a rapidity which is truly astonishing. Those vegetables which arrive at a marketable state in the least time are always the most profitable, and those also for which there is a constant demand at all times of the year. With an abundant supply of manure, the market-gardeners have no fear of exhausting the soil; and dissimilar vegetables may grow together on the same ground. Trees bearing fruit may be planted in rows, especially those of the dwarf kind; and under them those vegetables which do not require much sun may be raised to advantage. This is a very common arrangement in the market gardens near London. Raspberries, gooseberries, and currants are planted in the rows between the trees. These rows being thirty or forty feet apart, leave ample room for vegetables. But in those gardens where the finest vegetables are raised, and particularly in those which are appropriated to the growth of seeds, no trees are permitted to shade the ground: even the hedges, if there are any, are kept low and clipped, that they may not give any shade, or harbour small birds. The market-gardeners near London do not raise many peas or beans, except such as are forced and require glass frames to protect them. The chief supply of peas in the season comes from a greater distance, and is the produce of whole fields sown for that purpose by the farmers within a moderate distance of London. This crop would not be so profitable in a confined garden cultivated at a great expense.

The value of the produce in one year, from an acre of garden-ground in the most favourable situation, as stated by Mr. Middleton, from the account which he received from a market-gardener, is almost incredible. It is as follows:—radishes, 10*l.*; cauliflower, 60*l.*; cabbages, 30*l.*; celery (first crop), 50*l.*; (second crop), 40*l.*; endive, 30*l.*: making a total of 220*l.* for the gross produce of an acre in twelve months. The expenses of cultivation are very great. In inferior situations the produce is much less, but the expenses are also somewhat less. When it is considered that there are nearly 2000 acres thus cultivated, the gross amount of produce must be very great.

A garden should always be laid out in a regular form, with narrow parallel beds, and paths between them. One or more roads, of sufficient width to allow a cart to pass, should intersect these beds at right angles, for the convenience of bringing manure and taking off the produce. The beds should not be above six feet wide; so that a person may easily pull up weeds, or gather the vegetables without treading upon the beds. The surface-soil taken from the paths serve to raise the beds, and in retentive soils may carry off the superfluous water after sudden and violent rains. The whole ground should have been trenched two spits deep or more; and this trenching should be frequently repeated, to mix the upper with the under part of the soil, and distribute the decomposed dung throughout the whole depth. Thus in time a rich black mould will be produced, in which every kind of vegetable will grow most rapidly. For early plants, and those which are used in winter, and require to be protected from frost, narrow beds are made lying in a direction east and west, and sloping towards the south, with the north side raised high, so that their surface forms an angle of twenty or thirty degrees with the horizon. This gives the plants a protection from the north winds, and exposes them more to the influence of the sun. In very frosty weather, these beds are covered with mats or loose straw. We do not mention frames covered with glass, as they belong to a higher kind of horticulture: but a moderate hotbed made with fresh dung, and covered with mats laid over hoops, is indispensable for the raising of early vegetables. By these means radishes and various salads may be raised very early in the spring, and sometimes in mild winters, without any interruption during the whole year.

An abundant supply of manure is indispensable in a market-garden, and this can generally be obtained in large towns at a trifling expense. The neighbourhood of a town is therefore a necessary circumstance towards the production of the crop, as well as its sale. It would be impossible to make a sufficient quantity of manure by means of the horses which are employed to carry the produce to market; and the extent of land usually laid out in garden-ground could not raise sufficient food for cattle, without taking up a space which may be more profitably employed. The only animal which can be kept to advantage by a gardener is a pig. This animal will live well on the offal of vegetables; and the gardens of cottagers could not well be kept in a fertile state if it were not for the manure made by the pigs.

The market-gardeners about Amsterdam are mostly Jews, and the vegetables which they bring to market are similar to those of the London or Paris gardeners; but they excel particularly in raising cauliflowers, large white cabbages for making *saur-kraut*, a dish much relished in the winter by the Dutch and Germans [Cabbage], French beans, cucumbers, and melons. They raise these last in such abundance, that heaps of them are sold in the markets at a very low rate. They also excel in the forcing of early peas and beans, and in the general management of hotbeds.

The profits of a garden near London, of the extent of ten or twelve acres, are as great as that of a farm of ten times the extent cultivated in the best manner, without the help of purchased manure. But if manure can be obtained at a reasonable rate, as is often the case in great thoroughfares, where many horses are kept for public conveyances, although there be no immediate demand for vegetables, a garden may be very profitably cultivated, entirely for the purpose of raising seeds. This branch of industry is the more worthy of notice, as it may enable a cottager to improve his situation greatly by the produce of a small garden or allotment of land. The demand for seeds of all the most common productions of a garden, and especially of flowers, is great beyond belief, and the profit of those who retail them in small quantities is so great that they can afford a liberal price to those who raise them with proper care so as to keep the varieties distinct.

In some agricultural districts it is the custom for the labourers to plant turnips in their gardens in November, in order to obtain the seed in time for sowing in the next year. They choose the soundest and best shaped, and by attention in keeping the ground clean, and allowing only one sort to go to seed within a certain distance, they produce a better seed than the farmer could; because the labourer and his family having their garden constantly in view, can more easily keep off birds and watch the ripening of the seed, so as to allow it to come to perfect maturity, without danger of the pods bursting, and shedding the seed from being left too long. Thus they can collect a bushel or two of excellent seed from a small portion of land; and this, at the price of a guinea a bushel, which is cheaper to the farmer than if he raised it himself, or purchased it of the seedsman, is a very profitable crop to the labourer. An industrious cottager, without losing any time, with the help of his wife and children, may much increase his comforts in this manner, while at the same time he trains his children to habits of industry. To no class of men would a knowledge of garden husbandry be more useful. The improvement which may be made in the condition and character of the poor, by combining in their education a knowledge of the most common arts of life with that of letters, which is often the only thing taught in schools, must be evident to every man who has reflected on the subject; and of all these arts the most generally useful amongst an agricultural population is the art of horticulture. The cottager who is acquainted with the means of raising early garden produce, who can graft young trees, who knows what plants may be propagated with a little care, and be readily sold when in perfection, can employ his labour with a double advantage. And many a man, from a very small beginning, has, with a moderate share of judgment and prudence, raised himself to independence, if not to affluenee; while he that plods on in the beaten track, like a horse in a mill, ends his days in ignorance and poverty.

The great superiority of those schools which have been established to teach the children of the poor to work as well as to read, over those which teach book knowledge only, is indisputable. A boy who can manage a little garden, who takes a pleasure in watching the seed he has sown, who plucks out every weed as soon as it appears, and who prides himself on the fruit and vegetables which he can place on his father's table, is more advanced in his education than he who can only read and write, however well he may do both.

Many plans have been proposed for the distribution of the crops in a cottage garden; but none of them are suited to every situation. Much depends on the nature of the soil, which may be better suited to one kind of produce than another; and also to the demand for any peculiar class of vegetables. New sorts may often be introduced with advantage. The raising of any useful plant with great care will often give a man a reputation, which makes it advantageous to him to confine himself to these principally, and raise them in the greatest perfection. An ingenious man will find out what is most for his own advantage; and from the list of plants which may be cultivated for ornament or for use a selection may be made which may be well suited to the situation of the ground and the circumstances of the grower. The practice of the market-gardeners may be examined with advantage; and long experience, with the test of profit, will lay down better practical rules than the most plausible theories.

An allotment of land such as is now very frequently given to agricultural labourers with the laudable intention of making them more industrious and independent of parochial relief, may be cultivated to great advantage by applying judiciously the general principles of garden husbandry. There are few cottages which have not already attached to them a small garden of a few perches, in which common vegetables, such as cabbages, onions, and early potatoes, are raised. The same vegetables may continue to be cultivated there, provided the situation is more convenient from its proximity to the cottage, or a small part of the allotment may be set apart every year for this purpose, so as to change the crops, which is always an advantage. But the remainder of the allotment should be cultivated on a regular plan, as a farm in miniature, with this difference, that all the operations should be performed with the minute attention of a gardener. Potatoes and wheat, if the soil is not too light for the latter, or rye, in very sandy soils, will be the principal crops, being immediately necessary to the support of the family. These crops have sometimes been recommended to be raised in every alternate year; but whatever be the tillage or manuring, there are few soils which will not soon be reduced in fertility by this constant succession. One-fourth of the land in wheat, and one-fourth in potatoes, is the utmost which can be profitably cultivated in one year. The remaining half of the allotment must produce pulse, roots, and green crops, by which animals may be fed and manure collected. An allotment of three acres will enable a cottager to keep a cow, by having a portion of it in clover or other artificial grass. In the 'Farmer's Magazine' for February, 1802 (p. 38), there is an article drawn up by Mr. John Sinclair, in which it is shown how this may be effected without difficulty. But as the allotments usually given to labourers seldom exceed half an acre, or at the most an acre, the keeping of a cow is out of the question; and the only animal which can be profitably reared and fatted is the pig, to which we shall therefore confine our observations. By means of pigs the cottager may greatly increase the profit which can be made from his allotment of land, keeping up at the same time a proper degree of fertility. One-half of his land must be cultivated to feed his pigs; besides the smaller potatoes which remain when the finest and best are taken out for the use of the family, he may give them beans, barley, carrots, parsnips, and turnips, especially the Ruta Baga, or Swedish turnip; and all the straw must be used for litter. If this be strictly attended to, the greatest possible profit will be made from the land, without any danger of its being exhausted and losing its fertility. The rotations will therefore be—potatoes, with a great quantity of manure; then barley; then peas, beans, carrots, parsnips, and Swedish turnips, manured; and after these wheat. The application of the garden husbandry must be in the preparation of the soil by deep trenching and digging, carefully drilling or dibbling all the seeds in rows, stirring the soil between the growing plants, and keeping the ground clear of weeds by the hand and the hoe. These last are the most essential part of the cultivation, and are to be performed by the wife and children. By daily attention to the progress of the plants, and continual assistance at critical periods, sometimes thinning out, and at other times transplanting to produce an equal crop, and treating every plant as if it were a rare plant in a garden, the ground may be made to produce more than double what the most attentive farmer could expect on a larger scale. The additional labour, which is all light, costs the cottager nothing; but the farmer could not afford to pay for it at the usual rate of wages. If he could find hands to do it, he could not ensure the minute attention which is naturally applied when the labourer is to receive all the advantage himself. The comfort which a well-managed allotment gives to a labourer with a numerous family is hardly credible by those who have not witnessed it; and if there were less profit, it would still be highly beneficial, in a moral and political point of view, that early habits of industry should be encouraged, and that the temptations which arise from want of employment should be taken away from the young by the useful and healthy occupations of the garden.

GLOUCESTERSHIRE AGRICULTURE. The climate of Gloucestershire varies according to the elevation of the land. In the valleys, especially those which are sheltered on the north and east, the temperature is mild. On the Cotswold Hills, the air is sharp and bracing, and as the progress of tillage has brought higher lands into cultivation, farm-houses have been built in situations which require a hardy race to bear the keenness of the air. The children who can be reared there are strong and healthy, but those who are born with delicate frames have little chance of life if not removed to a milder air.

The Vale of Gloucestershire is noted for the early maturity of every kind of agricultural produce, owing partly to the nature of the soil, but chiefly to the shelter afforded by the hills on the north and east. It is however subject to violent storms from the Atlantic, which sometimes sweep with great fury along the course of the valley.

In an agricultural point of view, Gloucestershire may be divided into the Cotswold, or hilly portion,—the Vale, and the Forest, including the Ryelands. The first district traverses the whole county from Chipping Camden to Bath, and is divided into the upper and lower Cotswold Hills.

The Vale runs from Stratford-upon-Avon to Bristol, and is divided into the vales of Evesham, Gloucester, and Berkeley. The Avon runs along the upper part of the vale, and the Severn in the lower. The Forest of Dean lies on the northern side of the Severn, extending to the river Wye, which bounds the county on that side. The Ryelands are a sandy district of the Forest, bordering on Worcestershire and Herefordshire. The soil on the Cotswolds is chiefly a calcareous sand, a few inches deep, resting on oolite, a calcareous freestone, commonly called stonebrash. The poorest is only fit for sheep-pasture; but the feed is very sweet, and the sheep thrive well on it. Where it has been improved by cultivation, and by the repeated folding of sheep, it bears tolerable crops of oats and barley, and where there is an admixture of clay in the loam, even of wheat. The lower parts of the hills, and the valleys which are between them, contain a better and deeper soil, evidently made by the washing down of the soil from the hills. Where the subsoil is impervious, the water is apt to accumulate; but by judicious draining some excellent arable and grass land is produced. The dairies in these situations are productive; and the cheese made there is similar to the North Wiltshire. Some parts of the Vale contain a very deep and rich soil, as at Welford and its immediate neighbourhood. The soil there is a fine black loam; to the south the soil is heavier, but still rich, and produces great crops of wheat and beans. There is also a red loam of a very rich quality, evidently the deposit left by the overflowings of the rivers. At a greater distance from the rivers up to the foot of the hills, the soil is chiefly of a tenacious nature, which produces abundantly, when well drained and cultivated. Silicious sand and gravel are found in a few spots, but not in sufficient quantity to form any considerable portion of the soil of the county, except in the Forest, where the soil is chiefly a decomposed red sand-stone, very barren, and scarcely fitted for the growth of anything but woods and coppice.

The cultivation of the soil varies according to its nature and fertility; and although very considerable improvements have been introduced of late years, the system generally adopted is that which has been prevalent throughout the interior of England for nearly a century past. The Bath and West of England Society, and the exertions of several public-spirited proprietors, have introduced improved methods and instruments; but they have only been slowly and very partially adopted. Two or three crops and a fallow are still the prevalent rotations on all the heavier lands. Turnips have been long the substitute for fallows on the lighter soils; and the advantage of this useful root, as food for sheep in winter, is fully appreciated where many flocks are kept on the hills in summer. On the best managed light-land farms, the rotation is—1, turnips; 2, barley; 3, clover and grass mown; 4, the same fed with sheep and cattle; 5, wheat; 6, oats, vetches, or peas. The oats are sometimes succeeded by sainfoin, the seed of which has been sown amongst them. This sainfoin remains seven years before it is broken up.

In the rich heavy lands the rotation is fallow, wheat, beans, wheat.—On good light loam, 1, turnips; 2, barley; 3, grass mown; 4, ditto fed; 5, wheat. In most soils the wheat is not so good nor so free from weeds when the ground is broken up from a second year's grass, as it is after the first year; but the advantage of a fresh pasture, without additional expense of tillage, induces the farmer to let his clover and grasses remain two years on the ground. Experience has shown that, except in very rich soils, this is not the most profitable course.

In the thin light soils of the Cotswolds, wheat is not very productive; but the value of this grain induces the farmer to sow it, where oats would often be more profitable, from the greater certainty of the crop. The Cotswold land is injured by too much stirring; it is therefore ploughed with a very shallow furrow, or only *ribbled*, which is done by leaving a solid portion between every two furrows. The land is afterwards scuffled, or torn to pieces by an instrument with many teeth like a scarifier, which destroys the weeds and gives a sufficient tillage for sowing the wheat. The sheep, which have been folded on the land before the seed was sown, are repeatedly driven over the fields after the wheat is put, that their tread may give firmness to the ground, and prevent the wheat from being thrown out by the frost.

The broad-cast mode of sowing is almost universal. The few proprietors and farmers who use drills form an exception to the general practice. Very few have tried the setting or dibbling of wheat, which is so common in Essex, Suffolk, and Norfolk. The only crop which is dibbled or set is beans. They are planted in rows ten inches or a foot apart, in a direction across the ridges, which makes the process of hoeing more effective. In order to keep the rows straight and at equal distances, the dibblers stretch two lines, which are moved as soon as the beans have been planted along them; a bush-harrow drawn over the land fills the holes made by the dibble, and covers the seed. They are generally hoed twice: the first time, as soon as the beans are fairly out of the ground and show four leaves; the second, when they are about a foot high—a practice which greatly assists the growth. The hoeing is all done by hand, the horse-hoe not being much known in this country. Both winter and spring vetches are sown in considerable quantities for sheep food; among the first some rye is usually sown, and oats among the latter; these tend to support the stalk of the vetches, and keep them from the ground. This crop is not only very useful by supplying food for cattle and sheep at a time when green food is scarce, but by the closeness of its growth cleans the land effectually, choking all the annual weeds which may have come up.

Turnips are usually sown broad-cast, and hoed twice. They are fed off by sheep folded on them. A ton of hay per acre is given to the sheep while they feed on turnips; a very excellent practice where hay is not too valuable, by which the ewes are kept in good condition for yeaning, and the lambs are strong and healthy when they fall.

In the rye-lands, which are peculiarly adapted to the growth of turnips, an early quick-growing sort is frequently sown in July, and taken off in time for sowing wheat after it; this is exactly the Flemish practice, by which a good crop of turnips may be raised between the reaping of the rye and the sowing of the wheat. In the rye-lands this is not exactly the case, for the turnips are usually sown on a fallow, but in some places the clover, after having been fed off the second year till Midsummer, is ploughed up, and quick-growing turnips are sown immediately. The turnips come off in September, and leave the land in good condition for sowing wheat. They may also be sown after winter tares have been fed off, and in either case the most would be made of the land in one year. Rye was at one time the chief produce in the sandy soil, which has taken its name from this crop; but it has been found that wheat may be raised on these lands by means of lime and marl, and careful cultivation. It has therefore very generally superseded the rye, which is now generally sown for early sheep feed. Two bushels of rye are sufficient to sow on an acre if the crop is to be reaped; for green food three bushels are usually sown.

Flax was formerly cultivated to some extent in the Vale, but the belief that it was a very scourging crop, and returned nothing to the land, has led to the general prohibition of it in leases. Injudiciously managed, it is no doubt a crop which much diminishes the fertility of the soil; but with proper precautions it might not only be sown to advantage, but enter into the regular rotations, as in Flanders. [FLAX.]

Potatoes are raised in the rich light loams in considerable quantities. They are usually planted by dropping the sets after the plough in every second or third furrow. Twenty bushels thus set and moulded up with the plough will produce 300 or more. They are chiefly cultivated in the neighbourhood of the towns, and seldom consumed on the farm, but the manure purchased in the towns make up for the exhaustion produced by this crop. In a county of which the greatest part of the subsoil is calcareous, sainfoin is a most valuable production; it grows in poor chalky soils and remains in vigour for many years. If the soil has been well prepared before the seed is sown, sainfoin is perhaps the most profitable crop which can be raised: after the first year it costs only the mowing and making into hay, and this hay is only surpassed in nutritive qualities by the best clover.

Teasels (*Dipsacus fullonum*) are raised for the use of the manufacturers of woollen cloth; but not to such an extent as they were once. They are a very profitable crop when they succeed, but precarious both in produce and in value. Old pastures broken up are the most suitable to this crop. The sward is simply ploughed over, and the seed of the teasels sown and covered by a bush-harrow. Two or three pecks are sufficient for an acre. The teasels are sown in March, and cut in the second year, when they are sometimes worth from 30*l.* to 50*l.* per acre. The same ground will bear teasels for several successive years, if some seed is scattered in the vacant places where the plants have died. Gloucestershire contains grass-lands and meadows equal for richness to any in the kingdom. Some of these are on the banks of the Severn, Avon, and other rivers; others are upland meadows and rich cow pastures. Those which are capable of irrigation, or are periodically flooded, are mown every year, and the hay is generally sold to feed the horses of tradesmen or manufacturers, and is also sent by water in considerable quantities to the Welsh collieries.

The meadows on the Ledden are particularly fertile, from the rich soil which this river brings down from Herefordshire; but they are also subject to sudden floods in summer, by which the whole crop is sometimes spoiled or swept away. The rich upland meadows contain the best grasses, such as the *Anthoxanthum odoratum*, *Trifolium repens*, *Lathyrus pratensis*, and *Festuca pratensis*, which are all well known as indicating the richest natural pastures. These meadows are usually pastured and mown in alternate years, if they are not kept altogether for pasturing cows and feeding oxen, which is generally the surest method to obtain a certain and regular profit from them. When the same meadows are mown repeatedly, they are manured with dung mixed with scrapings of roads, ashes, and the sweepings of streets, where they can be procured. This is the case chiefly in the dairy farms, where the old pastures are kept untouched for the cows, that the cheese may maintain its reputation. The land which has been manured and mown is kept for the horses and dry cattle only.

Gloucestershire is essentially a dairy country, and has been always renowned for its butter and cheese, of which great quantities are made and sold in every part of the kingdom. London alone consumes a large proportion of it. [BUTTER; CHEESE.]

The Gloucester breed of cows, although now eclipsed in public estimation by the improved short-horns and the Devon, has qualities which make them still be favourites with many experienced dairymen. Their colour is generally a dark red or brown, with a white stripe along the back, or at least on the rump, extending to the tail. A cross between this breed and the long-horned is preferred by some, while others assert the superiority of the pure long-horned stock, improved by Bakewell and Fowler. The Durham short-horned breed of cows is however gaining ground for the dairy, as the active Devon oxen are for the plough. On rich pastures the large Herefordshire oxen fatten to the greatest weight at an early age; but in this last respect the best breeds of short-horns have a decided superiority in the opinion of many experienced farmers.

The produce of a good cow should average from 3½ to 4½ cwt. of cheese in the year, or from 12 to 18 quarts of milk per day. Some very good cows will give 24 quarts every day, at two milkings, for seven months after calving; but the pasture must be rich and abundant. After this the quantity diminishes rapidly till within six weeks of her calving again, when she is no longer milked. The profit on a dairy of 20 cows, kept on 40 acres of rich pasture, is calculated, in the excellent 'Agricultural View of Gloucestershire,' by Mr. Rudge, at 136*l.* 10*s.* per annum. The price of the cows he states at 400*l.*, which is 20*l.* each; a high price, which implies a very select stock. The cost of the requisite utensils of the dairy is only 23*l.* 16*s.* 4*d.*

The sheep peculiar to this county are the Cotswold and the Ryeland breeds. The first are large in the carcass, and rather strong in the bone, and the wool is coarse. At three years old a Cotswold sheep will weigh from 22lbs. to 30lbs. per quarter, and give 9lbs. or 10lbs. of wool per fleece. This breed has been successfully crossed with the improved Leicester, and also with the South-Down, in both cases with decided advantage; so that the pure original breed is scarcely to be met with. The improved cross with the South-Down is now in considerable repute with some, while others cry it down, and prefer the mixture of the Leicester blood; as both crosses have their supporters, it is probable that they may both be useful in particular situations. The Cotswold sheep will impart bulk both in flesh and wool; the Leicester increase the aptitude to fatten; and the South-Down improve the shape of the carcass and the quality of the wool. Careful and repeated experiments can alone decide which cross may be the best. The Ryeland or Herefordshire sheep are bred in the Forest district already mentioned. They are small in size, but larger than the common Forest sheep, weighing from 12lbs. to 14lbs. per quarter at three years old. They have white faces and no horns; the wool is very fine; and when they are fattened the flesh is of a very delicate flavour. This breed has been improved in size by crossing with the Leicester and black-faced Shropshire breeds, but always at the expense of fineness in the wool and flavour in the mutton. When crossed with the Merino, the Ryeland sheep produce a wool which bears a good price. This breed is perhaps the best to produce crosses with the Spanish, when the fineness of the wool is the principal object.

There are not many horses bred in this county, although they are generally preferred to oxen for the purposes of husbandry. The chief supply comes from the northern counties.

There are fine orchards in different parts of the Vale and Forest districts, and some very good cider and perry are made in the county.

The Forest of Dean antiently contained much valuable timber, chiefly chestnut, oak, and beech. It has been gradually much denuded of trees; so that there are large tracts of land entirely bare.

There are in the Forest, and dispersed through the county, many productive coppices, which are cut every ten, twelve, or fifteen years, and give good returns on land which is scarcely fit for any other purpose, or which would require a great outlay to bring it into cultivation. Many wastes, commons, and common-fields have been inclosed and improved, and there is not much land uncultivated which would give any adequate return for the expense of tillage. Much of the Vale land and some of the Forest might be rendered more productive by the application of draining, liming, trenching, and other modes of improving land, which experience, founded on national experiments, has introduced into other parts of the kingdom. Many cold wet bottoms might be made sound pasture by a good system of draining; and many pastures, of little value in their present state, might be improved by judicious tillage and cropping, and then restored to the state of permanent grass, if it appeared best adapted to that purpose. Although many improvements have been made of late years, there is still ample room for more, and the soil of this county might be made to produce a greater supply of food, both animal and vegetable, than it does at present.

GRASS LAND may be divided into water-meadows, upland pastures, and artificial grasses. The first are treated of under Irrigation: the nature and management of the two last we shall here briefly describe. Upland pastures are portions of land on which the natural grasses grow spontaneously, varying in quantity and quality with the soil and situation. The plants which form the natural sward are not confined to the family of the gramineæ, but many other plants, chiefly with perennial roots, form part of the herbage. In the richest soils the variety is exceedingly great. When a sod is taken up, and all the plants on it are examined, the species will be found more numerous than we should have believed possible;* and in the same ground the plants will vary in different years, so as to induce one to conclude, that, like most other herbaceous plants, the grasses degenerate when they have grown for a long time on the same spot, and that a kind of rotation is established by nature. It is chiefly in those pastures where the grasses are allowed to grow till they form their seed that this is observable; for when they are closely fed, and not allowed to shoot out a seed-stem, they are less subject to degenerate and disappear. This may be a reason why experienced dairymen are so unwilling to allow their best pastures to be mown for hay. They pretend that the feed is deteriorated in the next year, and that inferior grasses are introduced which injure the quality of their butter and cheese. Close feeding is always considered as the most advantageous, both to the cattle and the proprietor.

The only way in which a pasture can be profitable is by feeding stock; and its value is in the exact proportion to the number of sheep or cattle which can be fed upon it in a season. Extensive pastures are often measured only by their capacity in this respect. Thus we speak of downs for 1000 sheep; and in Switzerland and other mountainous countries they talk of a mountain of 40, 60, or 100 cows, without any mention of extent in acres.

When a pasture is naturally rich, the only care required is to stock it judiciously, to move the cattle frequently from one spot to another (for which purpose inclosures well fenced are highly advantageous), and to eradicate certain plants which are useless or noxious, such as docks and thistles, furze, broom, briars and thorns, which, not being touched by the cattle as long as they have better food, would increase and overrun the ground, and take up a space which would be more profitably occupied by good herbage. The dung of the cattle also, when left in heaps as it is dropped, kills the grass and introduces coarse and less palatable plants. This must be carefully beat about and spread, or carried together in heaps to make composts with earth, to manure the poorer meadows or the arable land. All that is required in rich pastures in which cows and oxen are fed, and which are properly stocked, is, to prevent the increase of the coarser and less nutritive plants. Weeding is as important in grass as in arable land; and if it is neglected, the consequence will soon be observed by the inferior quality of the feed. The urine of the cattle is the manure which chiefly keeps up the fertility of grass land; and although in hot and dry weather it frequently burns up the grass where it falls, when it is diluted by showers the improved appearance of the surface shows that its effect has not been detrimental. To enrich poor meadows there is no manure so effective as diluted urine, or the drainings of stables and dung-hills.

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* In a sod of grass taken from Selborne Common, the following grasses were found:—Plantago lanceolata, Agrostis capillaris, Avena flavescens, Dactylis glomerata, Festuca duriuscula, Poa annua, Cynosurus cristatus, Trifolium repens, Crepis tectorum, Achilea millefolium, Galium verum, Hypochæris radicata, Hieracium pilosella, Thymus serpyllum. (Curtis *On Grasses.*)

When pastures are poor, and the herbage is of a bad quality, the cause is to be sought for in the soil. A poor arid soil is not fitted for grass, nor one which is too wet from the abundance of springs and the want of outlet for the water. These defects can only be remedied by expensive improvements. A soil which is too dry may be improved by cultivation and judicious manuring; but for this purpose it must be broken up and treated for some time as arable land: and it may be a question whether or not the expense of improving the soil will be repaid by the superior quality of the pasture when it is again laid down to grass. In general the poor light soils, if they are worth cultivation, answer better as arable land, especially where the turnip husbandry is well understood. The low wet clay soils may be converted into good pastures by draining them well; and the improvement thus produced is so great, that judicious draining in such soils is the most profitable investment of capital.

When old meadows have been neglected, or too often mown, without being recruited by manure or irrigation, they are often overrun with moss or rushes, and produce nothing but a coarse sour grass. In that case, besides draining it if required, the land must be broken up and undergo a regular course of tillage, until the whole of the old sward is destroyed, and a better collection of grasses cover its surface. If this be done judiciously, the pasture will not only be greatly improved in the quality, but also in the quantity of the grass. There is a natural prejudice against the breaking up of old grass land. This has arisen from the improper manner in which it is frequently effected. The sward when rotten is a powerful manure, and produces great crops of corn. These tempt the farmer to repeat the sowing of corn on newly broken up lands. The fertility is reduced rapidly; and when grass seeds are sown after several crops of corn, the soil has been deprived of a great portion of the humus and vegetable matter which is essential to the growth of rich grass. The proper method of treating grass land, broken up to improve it, is to take no more corn crops than will pay the expense of breaking up, carting earth, lime, or other substances upon it, to improve the soil, and to lay it down to grass again as soon as the old sward is fully destroyed.

If the soil is fit for turnips, no better crop can be sown to prepare for the grass seeds, which should be sown without a corn crop, except where the sun is powerful, and the seed is sown late in spring: but autumn is by far the best season for sowing grass seeds for permanent pasture. Turnips of an early kind may be sown in May, and fed off with sheep in August or September; and the ground being only very slightly ploughed, or rather scarified, and harrowed fine, the seeds may be sown and rolled in. The species of grasses sown must depend on the nature of the soil; but it is impossible to be too choice in the selection. That mixture of chaff and the half-ripe seeds of weeds, commonly called hay seeds, which is collected from the stable lofts, should be carefully rejected, and none but seeds ripened and collected on purpose should be sown. The Trifolium repens (white clover), the Trifolium medium (cow grass), Medicago lupinula (trefoil), Lolium perenne (rye grass), the poas and festucas, are the best kinds of grasses. A very easy way of obtaining good seed is to keep a piece of good meadow shut up from the cattle early in spring, carefully weeding out any coarse grasses, and letting the best arrive at full maturity; then mow and dry the crop, and thresh it out upon a cloth. This will give the best mixture of seeds; but some of the earliest will have been shed, and these should be collected separately, or purchased from the seedsmen. Before winter, the ground will already be covered with a fine green, if the seed has been plentiful. The quantity per acre of the mixed seeds should not be less than 30 or 40 pounds to ensure a close pile the next year. If the soil is not naturally rich, liquid manure, or urine diluted with water, should be carried to the field in a water-cart, and the young grass watered with it. This will so invigorate the plants, that they will strike and tiller abundantly. They should be fed off by sheep, but not too close. The tread of the sheep and their urine will tend to make the pile of grass close; and the year after this the new pasture will only be distinguished from the old by its verdure and freshness.

In some soils which are not congenial to grass the seed does not take so well as in others; and there is a great difficulty in producing a good sward. In this case recourse may be had to planting, or, as some call it, inoculating grass. This is done by taking pieces of sward from an old meadow, and spreading them over the surface of the land to be laid down, after it has been ploughed and prepared in the same manner as it would be to receive the seed. The turf of the old meadow is taken up with a peculiar instrument in strips two inches wide, and these strips are cut across so as to form little square pieces, which are spread over the ground, leaving about five or six inches of interval between every two pieces. The heavy roller presses them into the ground. These tufts soon spread and fill up all the intervals with a complete old sward. This is a very effectual and certain method of producing a permanent pasture. Some attention is required to prevent weeds in the intervals between the tufts at first: by going over the field with a narrow hoe all weeds may be easily kept down; and the roots and tillers of the grass soon fill up the vacant spaces.

The fertility produced by grass which is fed by cattle and sheep has given rise to the practice of converting arable land to pasture for a certain time in order to recruit its strength. The old notion was that the land had *rest*, which by a confusion of ideas was associated with the rest of the labourers and the horses. Ploughing was called working the land; and some men talked of working out the heart of the land by ploughing. That the ploughing of land does not diminish the productive power of all soils that are fit for cultivation will be readily allowed. The sea-sand no doubt, where a few bents have taken root, would not be improved by being stirred; neither would very light soils under a burning sun; but in our moist climate there is seldom any danger of over-ploughing. The land, by being in grass, has much vegetable matter added to it from the fibres of the roots which die and decay, as well as from the other parts of the grass, which draw nourishment from the atmosphere and impart it to the roots. Thus in time an accumulation of humus is formed; and when the land is ploughed, the rotting of the sward greatly increases it. Every species of plant thrives well in this improved soil; and the vigour of the growth is ascribed to the recruiting effects of rest, by a fancied analogy with the animal muscle, which is invigorated by occasional inaction.

But setting aside theory, it is well known that land which has been some years in grass is improved in fertility. The convertible system of husbandry takes advantage of this fact; and all its art consists in reproducing a good pasture without loss of time, after having reaped the benefit of the fertility imparted to the land during three or four years when it was in grass. Good pasture is very profitable; so are good crops: by making the one subservient to the other, the farmer who adopts the convertible system is enabled to pay higher rents, and still have a better profit than those who adhere to a simple rotation of annual crops.

When an arable field is sown with the seeds of grasses and other plants which give herbage for cattle, it is called an artificial meadow, and the various plants which are raised are all called artificial grasses, although many of them have no botanical title to the name of grass, such as clover, sainfoin, lucern, and many others, which produce the best pastures and the finest hay.

In laying down a field to grass for a very few years the mode of proceeding is somewhat different from that which is recommended for producing a permanent pasture. Clover in this case is always a principal plant, both the red and the white; these, with annual or perennial rye grass, are sown with a crop of corn in spring, and begin to show themselves before harvest. The grasses are often mown the first year after they are sown, on account of the abundance and value of the red clover, but the best farmers recommend the depasturing them with sheep, to strengthen the roots and increase the bulk. Various circumstances, such as a greater demand for clover hay, or for fat cattle, may make mowing or feeding most profitable; but when there is not a decided advantage in making hay, feeding should always be preferred. At all events the great object of the farmer should be to have his land in good heart and tilth, and free from weeds, when the grass is sown. If his grass is good, he is certain of good crops after it with little trouble or manure.

The seeds usually sown on an acre, when the land is laid down to grass, are as follows:—Red clover, 12 lb.; white, 6 lb.; trefoil, 4 lb.; rib grass, 2 lb.; and 2 pecks of Pacey's rye grass. Sometimes cockfoot grass (Dactylis glomerata) and cow grass (Trifolium medium) are added. This is for a field intended to remain four or five years in grass.

The introduction of artificial meadows in districts where the soil seemed not well adapted for pasture, has greatly increased the number of cattle and sheep reared and fattened, and has caused greater attention to be paid to the means of improving the breeds of both. Thus a double advantage has arisen: the public is benefited by an increased supply, and the farmer is rewarded by an additional source of profit.

In the neighbourhood of large towns there are many meadows, which, without being irrigated, are mown every year, and only fed between hay harvest and the next spring. These require frequent manuring to keep them in heart, and with this assistance they produce great crops of hay every year. The management of this grass land is well understood in Middlesex. Sometimes the meadows are manured with stable-dung which has been laid in a heap for some time, and been turned over to rot it equally. This is put on soon after the hay is cut, and the rains of July wash the dung into the ground; but if a very dry and hot summer follows, little benefit is produced by the dung, which is dried up, and most of the juices evaporated. A better method is to make a compost with earth and dung, and where it can be easily obtained, with chalk, or the old mortar of buildings pulled down. The best earth is that which contains most vegetable matter; and as many of these meadows are on a stiff clay soil, which requires to be kept dry by open drains and water-furrows, the soil dug out of these and carted to a corner of the meadow makes an excellent foundation for the compost. It is sometimes useful to plough furrows at intervals to take off the superfluous surface-water in winter; the earth thus raised by the plough is excellent to mix in the compost; having been turned over with dung, sweepings of streets, or any other manure, so as to form a uniform mass, it is spread over the land in winter; and in spring a bush-harrow is drawn over the meadow, and it is rolled with a heavy roller. All this compost is soon washed into the ground, and invigorates the roots of the grass. It is better to put on a slight coating of this compost every year than to give a greater portion of manure every three or four years, as is the practice of some farmers. When grass land is let to a tenant, it requires some attention, and particular conditions in the lease, to prevent the meadows being deteriorated by continual mowing without sufficient manuring, which might be the case near the expiration of the lease. It is very common to insist by a clause on a cart-load of stable-dung being bought for every load of hay which is made and not consumed on the premises. Sometimes the tenant is bound to feed the land in alternate years; but if horses or heavy cattle should be taken in, especially in spring and autumn, they may do more harm by their treading, when the ground is soft, than would have been done by taking off a crop of hay. When the proprietor of meadows resides near them, he often finds it most profitable to keep them in hand, and sell the crop when it is fit to be mown. In that case he must be careful to manure them sufficiently, or his profits will soon diminish rapidly. The grazing of cattle has generally been a more profitable occupation than simply tilling the land. The capital required is considerable, but the current expenses are not great. The grazier is not subject to such total failures as the farmer of arable land is in his crops. With a little experience and prudence, he can always reckon on a certain return. An acre of good grazing land, worth 40*s*. rent, is supposed to produce 200 lbs. of meat in the year. If this is worth 6*d*. a pound, the gross produce is 5*l*. per acre. The expenses will not exceed 10*s*. per acre, so that here is a net profit of 2*l*. 10*s*. per acre with little or no risk; few arable farms will average this net profit. By uniting the raising of corn and the grazing of cattle and sheep, the greatest profit is probably obtained, and this is the great argument in favour of the convertible system of husbandry.

GYPSUM. — Gypsum generally contains a portion of silica and alumina as well as of lime, and it is to this combination chiefly that it owes its peculiar plastic qualities: pulverized by grinding or burning, it forms a peculiar species of manure, of which the effects are striking in some cases, and altogether imperceptible in others. Its use as a manure was very partially known, until Mayer, a clergyman of Kupferzell, in the principality of Hohenlohe, in Germany, noticed it about the middle of the last century, in a correspondence with Count Von der Schulenberg, at Hehlen, in the electorate of Hanover, as having been long in use in the neighbourhood of Gottingen, as a top-dressing for young clover. Tscheffeli, the zealous Swiss agriculturist, soon after tried experiments with it; and his success introduced it very generally into Switzerland, where it continues to maintain its first reputation. It soon spread amongst all experimental agriculturists on the Continent; and it is generally considered as a proof of good farming when no reasonable expense is spared to procure gypsum or the Dutch peat-ashes, which are found on analysis to contain sulphate of lime. In England the result of experiments with gypsum has not always been so favourable, and the use of this manure has not been so generally adopted. In some instances the benefit was evident, in others not even perceptible. The doubt thus thrown on its efficacy has caused it to be neglected. In our opinion, the condemnation of it is not founded on solid grounds. It is allowed that in cold wet soils its effects, as also that of bones, are not very encouraging, nor on very poor soils: but on good loams containing a due proportion of humus, and on all light and dry soils which are not very poor, or have had a due portion of manure, its effects are striking. We have ourselves experienced the benefit of gypsum, not only on clover, but on peas, tares, and beans, where the soil was in good heart and well drained. The portions of a field sown with gypsum were decidedly superior in vigour and luxuriance of growth to those where it had not been used. So far we can bear testimony to its use.

It has been found extremely efficacious in some soils of North America. Benjamin Franklin is said to have been one of the first to try its fertilizing power on clover. He sowed it in a clover-field near one of the high roads in Pennsylvania, so as to form the letters of a sentence such as the following: "This is manured with gypsum;" and the effect was such, that the letters could be readily distinguished by the height and colour of the clover where the gypsum had been sown. This naturally drew the attention of all those who passed along; and no better method could have been adopted of spreading its fame. From that time gypsum has been regularly imported into America for manure from Havre, to which port it is brought by the Seine from Paris.

Although the exact manner in which gypsum acts in increasing the vigour of certain plants is not yet clearly shown, we know by experience that it is generally beneficial in proportion to the quantity of humus in the soil; that it is of little use where the land is wet and not well drained; and that its effects are most conspicuous in light loams, gravels, and sands, provided they be not too poor. It has little effect in promoting the growth of wheat, oats, and barley ; but all plants with broad leaves are benefited in proportion as the dust lodges on the leaves. In a case where the wind had carried the powdered gypsum over part of a hedge of whitethorn, it showed its effects by making that part much richer in foliage than the rest. From this circumstance it has been recommended to be sown in moist still weather, late in the evening, or early in the morning, that the dew may make it adhere to the leaves. The heat of the sun drying the leaves would prevent this; heavy showers will also wash it off: and therefore a showery time should be avoided. A gloomy hazy day is the most favourable.

The plants on which the gypsum produces the greatest effects are those of the papilionaceous order, such as clover, peas, beans, vetches, sainfoin, and lucern. It is also useful to those of the cruciform order, as colza, rape, and mustard, and probably turnips, although it has seldom been tried on these; we have found it produce a visible improvement in beans in a heavy loam, and on vetches in a lighter soil, but in both cases the land had been well manured and was in good heart. We would by no means recommend it as a substitute for dung, but as an assistant to it; considering it as a stimulant, as wine is in the digestion of our food. In both cases an excess may do harm.

There are two modes of pulverizing gypsum: by burning it to dissipate the water of crystallization; and by grinding it in a mill, or pounding and sifting it. The last method, if done sufficiently, seems the best: for the burned gypsum, or plaster of Paris, attracts moisture so rapidly, and consolidates so soon, that the first shower converts the fine dust into lumps of hard stone, thus destroying its effect on the leaves; whereas the pounded gypsum does not set so readily, and remains in a fine powder. It is also more soluble in water than that which has been burnt; although water dissolves only a very small proportion of it before it is saturated. Gypsum is the substance which gives water the quality called hardness, which prevents its dissolving soap. The gypsum is deposited by boiling the water, and adheres to the sides of the kettle. Hence it is probable that where the water is naturally hard, gypsum may have little effect on the soil as a manure.

Gypsum has a septic quality, that is, it promotes putrefaction in animal and vegetable substances. It may therefore be a very useful ingredient in composts of which the principal part is farm-yard-dung. It should, however, be used sparingly, till its effects are more clearly ascertained. The Dutch peat-ashes and those from Newbury in Berkshire, which are in such repute as a top-dressing for clover, probably owe their power of accelerating the vegetation of this plant to the gypsum which they are known to contain. Dutch ashes, like gypsum, have little effect on cold clay soils, but act most powerfully in the light sands of Flanders.

This manure is well worth the attention of experimental agriculturists; and we doubt not that it will repay the trouble of making numerous and accurate experiments.

HAMPSHIRE AGRICULTURE.—The climate of Hampshire is generally mild and favourable to vegetation. The southern part of the Isle of Wight is considered to have the mildest climate in Great Britain, and is resorted to on that account by invalids during the winter. But a great part of Hampshire consists of poor sands and gravelly soils or chalky hills, having between them low bottoms, with no ready outlet for the water, which has produced marshes and peat-bogs. In such places the nature of the soil has a greater effect on the climate than the difference of several degrees of latitude would have under other circumstances.

The northern part of the county, where it borders on Berkshire and Surrey, consists chiefly of the poor dark sand, mixed with an ochery loam, which is well known as the Bagshot-heath soil. This extends to Basingstoke. The whole of this part of the county is naturally very unproductive, and till within a few years was almost entirely covered with a brown heath, on which some hardy forest sheep and a few miserable cattle were reared, and contrived to pick up a scanty living. There were, however, some spots between the hills which contained a few farm-buildings and some green fields, forming a striking contrast with the surrounding waste. Within the last thirty years much of this heath, which lay in common, has been enclosed and divided. Some of it has been brought into cultivation at a great expense, and a considerable portion has been planted with fir-trees, which have thriven wherever the proprietor was at the expense of trenching and draining the land before planting.

The great roads which traverse this part of the county, and the numerous places in which horses are kept for posting, stage-coaches, and waggons, have caused a supply of manure, by which the poor soils immediately around them have been much improved. The very poverty of the soil has set ingenuity to work to produce the most improved practices and implements. Most of the drilling-machines which are used within a certain distance in the counties of Surrey and Berks, as well as in Hampshire, are manufactured in the neighbourhood of Basingstoke.

South of this district, as far as Winchester and a few miles beyond it, the chalk prevails. The soil which lies over this chalk varies in depth, and, where it is sufficiently deep, produces good crops of barley, wheat, and oats. In many places it lies very near the chalk, and is intermixed with flints and pebbles. Although the appearance of it is not very promising, it is tolerably productive in good seasons; the pebbles and flints reflect the sun's beams, while the young plant is sheltered by them from the cold easterly winds which, in spring, sweep over the hills, where few trees break their force.

Where the soil is thin and very near the chalk, it is scarcely fitted for the plough, but remains in the state of down; and the natural grasses which grow there, when kept closely cropped by sheep, are sweet, and make the best sheep-pastures. If these downs are not sufficiently stocked, or if they are reserved for cows, the furze and brambles are apt to overrun them, and the coarse grasses get the upper hand.

In the valleys and along the lower slopes of the chalk-hills the soil is of a tough tenacious nature, being a mixture of chalk washed down the hills by the rains and stiff clay. This is a soil very difficult to cultivate. In spring it is extremely heavy, and retains moisture a long time, and when dried it becomes so hard, that unless it has been worked at the exact moment when it is dry on the surface, and the clods are still friable, there are no means of reducing it to a proper tilth. But when it is carefully managed and well manured, it produces very good crops of beans, wheat, and oats. This land can scarcely be cultivated and kept clean without occasional fallows, and the most profitable rotation is wheat, beans, oats, fallow. It is much too heavy for turnips. In some spots which are not quite so heavy the Suffolk rotation of barley, after a long fallow, clover, wheat, beans, and oats, might be introduced with advantage. It is not at all adapted to the Scotch convertible system; for although grass-seeds might grow well, the land could seldom be depastured with cattle, either in spring or autumn, and after a dry summer it would be almost impossible to plough it up in good time to sow it with wheat. On the eastern side of the county, bordering on Surrey and Sussex, is a small tract of land, which is provincially called malmy land, forming the vale of Petersfield. It has a grey, tender, sandy soil of some depth, lying on a soft sandstone, which is almost impervious to water. This circumstance counteracts the advantages of a light soil, unless the water be artificially carried off. On the higher grounds the poor sandy soil is only fit for plantations of firs.

The land in the New Forest, and on the opposite side of the river, or æstuary, below Southampton, is mostly of a light nature, intermixed here and there with heavier loams and clays. Where it is sound and free from springs it is of a good quality; and that which is not so may be materially improved by judicious under-draining. Some spots in the New Forest were effectually drained many years ago by Mr. Elkington, and have amply repaid the expense incurred, both by the improvement of the land and the greater salubrity of the neighbourhood; for where the land has not been drained, low bogs and marshy places are formed, which are the cause of frequent fevers and agues.

Various kinds of marl are found in many places; some of these are very useful on poor gravelly soils, which they greatly improve when a sufficient quantity is carried on. The value of marl depends on the union of carbonate of lime and clay, and is readily discovered by its effervescing strongly when any acid is poured upon it. When the quantity of carbonate of lime is small, very good white or red bricks are made of it. The white colour is caused by the calcareous matter, the red by the presence of oxide of iron.

The Isle of Wight consists principally of chalk, over which are found various soils, such as gravel, sand, and very stiff clay. The mildness of the climate is favourable to vegetation, and there are some neat farms, in which the land is well cultivated.

In traversing the whole country it will be observed that the poorer soils predominate, and a great part of the land will scarcely repay the expense of cultivation. There are a few fertile spots, and some very valuable water-meadows along the principal rivers, especially the Avon, which runs through the western part of the county bordering on Dorsetshire. Where a farm has a portion of water-meadow and a run for sheep on the downs, the occupier generally thrives; but the greatest agricultural skill is displayed in the cultivation of the poorer soils, where manure must be made on the spot, and the cattle and sheep kept on the produce of the arable land.

Hampshire, although it cannot be compared with some eastern and northern counties for agricultural improvements, is not far behind them; and there are some farms as well managed as any in England. The great fault lies in the want of economy of labour; too many horses are used; the thrashing-machine is not sufficiently common; the stock is not fed so economically as it might be; the manure is not so carefully collected, nor so well prepared, before it is put on the land; and there is a great waste of the liquid part of it on the best managed farms.

The old clumsy plough, once in general use, is now replaced by a lighter and more durable plough, of which the parts that wear out most are made of cast-iron. Two horses now plough land which formerly was thought to require four. The seed is put in by a drilling-machine, instead of being scattered by the hand. The corn is put into neat stacks, raised on stone pillars, and well thatched, instead of being exposed to the depredation of rats in a huge barn. The farm-buildings, as well as the house of the farmer, are more commodiously arranged, and there is a general spirit of improvement. The correction of the abuses of the old poor-laws, and the commutation of the tithes for a fixed annual payment, will much encourage the improvement of poor lands; and in half a century the general face of the county will be very different from what it is at present.

There are no breeds of cattle, horses, or sheep peculiar to Hampshire, unless we consider the small New Forest ponies in that light. The cows are of various breeds. The oxen are chiefly Sussex and Devon. The horses used in husbandry are mostly bred in other counties. The sheep are—the common small forest breed, or heath-sheep, which, when tolerably fat, give the high-flavoured mutton formerly known by the name of Bagshot mutton; the Dorset and Leicester sheep, in the richer meadows; and the South-Down, on the chalky hills. The last are most numerous, and preferred for folding on the land.

Hampshire has long been famous for the curing of bacon; and a Hampshire hog is a very common sign for a public-house; yet the native breed of pigs in this county is by no means remarkable for its qualities. The native hogs, which live on the acorns and beech-mast of the New Forest, although the flavour of their flesh may be good, are coarse, raw-boned, flat-sided animals, and are now seldom met with. The improved breeds produced by crosses of the Berkshire, the Suffolk, Essex, and Chinese pigs, are so much better and more profitable, that the only difference to be noticed in the pigs bred on different farms is that which arises from the predominant character of any one of the above-mentioned breeds.

The reputation of the Hampshire bacon is owing entirely to the care with which it is cured. The hogs being fatted on peas and barleymeal, are kept fasting for twenty-four hours, at least, before they are killed; they are used as gently as possible in the act of killing, which is done by inserting a long pointed knife into the main artery which comes from the heart. The hair is burnt off with lighted straw, and the cuticle of the skin scraped off. The carcass is hung up after the entrails have been removed, and the next day, when it is quite cold, it is cut up into flitches. The spare ribs are taken out, and the bloody veins carefully removed: the whole is then covered with salt with a small quantity of saltpetre mixed with it. Sometimes a little brown sugar is added, which gives a pleasant sweetness to the bacon.

The flitches are laid on a low wooden table, which has a small raised border all round it. The table slants a little, so as to let the brine run off into a vessel placed under it, by a small opening in the border at the lower end. The flitches are turned and re-salted every day; those which were uppermost are put under, and in three weeks they are ready to be hung up to dry. Smoking the bacon is no longer so common as it used to be, as simply drying it is found sufficient to make it keep. Those who, from early association, like the flavour given by the smoke of wood, burn sawdust and shavings in a smothered fire for some time under the flitches. When they are quite dry, they are either placed on a bacon-rack for the use of the family, or are packed with wheat-chaff into chests till they are sold.

The practice of cutting the hogs into pieces and pickling them in a vat, being attended with less trouble, is very generally preferred when there is only a sufficient number of hogs killed to serve the farmer's family; but flitches of bacon, well cured, are more profitable for sale.

The fatting of hogs is profitable when a pound of green bacon, when it is first dried, is worth more than the tenth part of the price of a bushel of barley, for a bushel of barley is supposed, with good management and a good breed of hogs, to produce 10 lb. of bacon. The risk and attendance are fully compensated by the value of the dung made by the hogs, which is of the richest nature. Hogs may be made fat with less expensive food, such as boiled roots mixed with meal; but in this case the bacon is much less valuable, and is not superior to the Irish bacon, which is mostly fatted on potatoes.

HARVEST is a most important period to the husbandman. When by his skill and industry the ground has been well prepared to receive the seed, and every circumstance has been favourable to the growth and ripening of his crops, he may be deprived of a great portion of his reward by an unseasonable time of harvest. Although the state of the weather is beyond his control, he may, by an attentive observation of the usual changes at particular periods of the year, anticipate its influence in any particular situation. The precautions which are necessary in a northern climate, where the fruits of the earth come late to maturity, would be superfluous in more southern latitudes. It is from the inhabitants of northern and mountainous countries that we are likely to learn the means of obviating the effects of an unfavourable season and a late harvest.

In those southern climates where the heat and want of moisture are not too great for the growth of corn, the only care of the farmer is to procure hands sufficient to reap it. The heat of the sun and air soon dry the straw and harden the grain. A spot is levelled in the field, and the corn is thrashed out immediately, either by the tread of cattle driven over it, or by the flails of numerous thrashers. The corn is winnowed and stored in granaries; and the straw is reserved till winter, when it forms the chief fodder of horses and cattle. In these regions the harvest is a continued feast; no ungenial weather disappoints the hopes of the husbandman. But in northern climates, where the harvest is later, and cold rains and storms are frequent in autumn, the ingenuity is often taxed to save the corn from being entirely spoiled, after it has been severed from the ground; roomy barns are erected to secure it in the straw, till it can be thrashed; and the joy of harvest is frequently interrupted by the anxiety which is the consequence of sudden changes of weather.

To lessen the casualties of harvest in a moist climate, the experienced husbandman endeavours to arrange the time of sowing each kind of grain, so as to ensure its coming to maturity in a regular succession. Thus he has more time to attend to the precautions of which experience has taught him the utility; and if the duration of harvest is longer, there is less danger of all his crops being spoiled by a wet season.

It was long the custom through the whole of the north of Europe to store all the produce of the farm into barns, especially the corn; and it was thought that as soon as the sheaves were collected under a roof, all danger was past. The increase of the produce raised on most lands by an improved system of agriculture gave rise to the practice of stacking corn in the open air, and securing it by a covering of thatch. It was soon found that the grain thus stored in the straw was better preserved than that which was in the barn; and the invention of stone or cast-iron pillars as supports for the frames on which the grain was stacked, not only secured it from the depredations of vermin, but kept it in a much drier state than when the stacks were made on the ground. This was a great improvement; and now, in the best managed farms, the only barns required are those in which the corn is thrashed; and if there is sufficient room to hold the contents of one stack of the usual dimensions, it is all that is absolutely required.

The want of room in the barns was probably one of the reasons why the reapers were permitted to cut the straw half-way between the ear and the roots, leaving more than half the straw in the field. Another reason also was the profusion of weeds which grew amongst the corn, and which retarded its drying, by retaining the wet much longer than the ripe straw. It was thought also that the seeds of weeds were thus prevented from mixing with the grain in the thrashing, and giving more trouble in the winnowing. The usual prohibition against selling any straw also made the farmers less careful to secure the whole. The stubble was mown after harvest, and formed into broad walls, called in some places *Haulm-walls*, round the yards where the cattle were fed in winter, for the double purpose of fodder and shelter. But it is evident that this practice is defective; there can never be too much straw to be converted into manure by the dung and urine of cattle, and what is left as stubble is much wasted before it is mown and carried into the yard. The seeds of noxious plants remain on the land, whereas they would be much more effectually destroyed if they were stacked with the corn. The subsequent separation of them is a very trifling additional labour, where a winnowing-machine is in use. It may therefore be admitted as a general rule in reaping, to cut the straw as near to the ground as possible: this is best done by an instrument called a *cradle scythe*, which mows the straw, and collects it so as to be readily gathered into sheaves.

The Hainault scythe has a very short handle, and is used with one hand, while the other collects the straw into a sheaf by means of a large hook at the end of a wooden rod. It is a most useful instrument, and greatly preferable to the fagging-hook in use in Middlesex and the neighbouring counties, where straw is valuable and sells at a high price. It cuts more straw at each stroke, and is less fatiguing to the reaper, because his position is nearly upright when he uses it. In many places it is not usual to tie up any corn into sheaves, except rye, wheat, and beans. Barley and oats are usually mown, raked into heaps, and carried into the stack or barn when dry, like hay; but this is a slovenly practice, which should not be recommended. With good tillage and proper manuring the straw of barley and oats will be strong, and of sufficient length to require being tied up into sheaves; and much less of the grain is shaken out and lost in this way than by the usual method.

In rainy seasons it frequently happens that the sheaves remain a long time in the field before they are sufficiently dry to be carried and stacked. If the ears are not secured from the wet, they become soaked, and the grain sprouts in the ear. This is a great loss; for sprouted grain is very inferior, and can only be sold at a low price. A little attention will often prevent the bad effect of rains. In some places six or eight sheaves are set up in a circle, with the butt-ends diverging, so as to admit the air to circulate among them; a sheaf is opened by spreading out the ears, and is placed inverted over the ears which lean against each other, forming a truncated corn. Thus the butt-end of the top sheaf is the only part in which the rain can lodge; and the first sunshine will soon dry this: the rain runs off the sides of the inverted sheaf, and the ears, pointing downwards, will not long retain the wet.

When the stack is building, the butts of the sheaves are placed outwards, and project gradually over the sides of the frame, and over one another, so as to build the stack in the form of a bowl, with a cone or pyramid over it, according as the frame is round or square; this is carefully thatched with straw, and the outer surface is cut smooth by means of shears. This not only saves all the ears which chance to lie outwards, and which would have become the prey of birds, but it also prevents the rain from beating into the stack and injuring the corn. It may then be considered as safe.

Where there are no raised frames, and the stack is built on the ground, or on a bottom made of faggots to keep it dry, a belt of plastering or stucco is sometimes laid, a foot wide, round the stack, about 18 inches from the ground, after the surface has been cut quite smooth and even. This contrivance is intended to prevent the rats from lodging in the stack, and it is very effective. A frame made entirely of iron, and supported upon iron columns, has lately been invented. It may readily be taken to pieces and put together again when it is wanted. The advantage of it is, that it is cheaper and more easily moved than any other; and it is very convenient for a temporary purpose.

Harvest is proverbially a joyous time, and one when hospitality is practised with more good-will than at any other season. The custom of giving a supper to the harvest men and women, when the last corn is carried, has been observed from time immemorial; and it is much to be regretted that in many farms it is now omitted, or a mere gratuity is given instead. The community of good feelings which ought ever to exist between the master and his servants or labourers, is most effectually kept up by occasional friendly intercourse; and a harvest-home supper was formerly a kind of Saturnalia in which every exuberance of spirit was allowed without fear of offence. The anticipation of it was an incitement to exertions in the field; and the farmer was amply repaid the expense which the feast occasioned. The stimulus of strong beer is still applied at harvest, and frequently to such a degree as to defeat its own object. In some places the labourers have a certain sum in addition to food *to finish* the harvest, whether it is a longer or shorter time. In others they have the usual weekly wages, and a gratuity at the end, with plenty of beer so long as it lasts: accordingly as labourers are abundant or not, the price is less or greater. Many thousands of Irishmen come over to England and Scotland in the time of harvest, and are of great use in finishing it in a short time.

HEDGE, one of the most lasting and effectual of our fences. When hedges have been well made, and are kept in good order, nothing can surpass them, except well-built stone or brick walls, and even these are far less effectual in keeping out trespassers of every description.

Hedges are made of various kinds of shrubs and trees, trained so as to throw out numerous branches along the stem from the surface of the earth upwards; this is done by judicious pruning when they are young. The head being cut off and the side branches shortened, numerous smaller branches spring out, which are shortened in their turn, and form a very compact mass, consisting of the ends of stumps and branches pointing in every direction. Those shrubs which are of a thorny nature are best adapted for hedges. Holly, which bears prickles on the edges of the leaves, is on this account by far the best shrub to form a hedge. But it has a great inconvenience in its very slow growth, and, except in very old gardens, which have been surrounded by a high holly hedge before the present generation was born, it is very seldom that such a hedge is met with. The high price which the nurserymen charge for this plant is another reason why it is more seldom planted.

In forming a holly hedge the ground should be prepared by trenching and abundant manuring: the plants should be most carefully planted after midsummer, or immediately before the usual rains which come at that season. There should also be a portion of virgin soil for the roots to spread in; and in planting they should be well divided, to give them the greatest possible extent from which to draw their nourishment. The earth should be well pressed to them by treading it down; and, in case of a continued want of rain, they may be occasionally watered, late in the evening, or early in the morning. By a little attention to them in the first year, they will form a good fence several years sooner than those which are comparatively neglected. The plants which are usually put in are three years old; but if they could be transplanted at once from the seed-bed, they would sooner come to perfection; and by being cut down and pruned earlier, would lay the foundation of a closer and better hedge. Next to holly, as forming a close and durable hedge, is the yew; it bears very close clipping, and forms a thick hedge and good shelter all through the year. For gardens and nursery-grounds, where shelter and occasional shading are required, the yew hedge is preferred; but in all places where cattle are put to pasture, they should never be permitted to grow. Many valuable horses and cattle have been destroyed by grazing in places where yew-trees grew; and notwithstanding the instinct which leads animals to reject food which is hurtful, they greedily eat the yew-leaves in spring. The same may be said of box.

The various kinds of thorns are peculiarly adapted to form hedges, and they are consequently by far the most common plants of which a live hedge is formed.

For high hedges and strong fences the hornbeam, and a variety of the beech which throws many branches from the stem, are extensively used in old gardens, where geometrical figures and numerous angles are admired.

Where it is desirable that the hedge should arrive very rapidly to such a size as to be a good defence against cattle, elder may be planted. Elder grows very rapidly, and throws out many long hollow branches, which soon become hard, and are admirably calculated for a fence, and cattle will not eat the leaves; but it is never very close or ornamental; and as it requires to be cut down frequently, it displays very unsightly knots and stumps when it has acquired a certain age.

Sweetbriar is ornamental, and forms a good fence against sheep. It is chiefly confined to flower-gardens and enclosures in pleasure-grounds.

Many other shrubs might be named, such as the *pyrus Japonica*, which is prickly, grows close, and bears a beautiful flower. It is as hardy as any native British plant, and will bear cutting and training as well as any of them. Hitherto no hedges have been made of this shrub, except a few in the gardens of nurserymen; but there is no doubt that if many young plants were wanted for hedges, they would soon be produced at a reasonable price. The privet is a very common and quick-growing shrub, which is frequently planted as a hedge where cattle are not admitted; but of all shrubs, the most common and most useful for the purpose of hedges are the black and white thorn, and they almost universally form the quick hedges by which our fields are separated and enclosed.

In order to have a good hedge, the shrubs should be planted in a soil which is naturally strong, but well pulverized.

and in which no shrub or tree has lately grown. The best soil is that which is produced by the decomposition of sods taken from commons or old pastures; and it is observed that in new enclosures, where the quick has been inserted between two sods, it always grows luxuriantly, and only requires to be protected, when young, against the cropping of sheep and cattle, which are fond of the young tender shoots. The usual mode is to insert, in the early part of the spring, two or three rows of quick in the side of the bank, on a level with the surface of the ground, where a sod has been turned over, and forms the base of the bank raised by the earth taken out of the ditch. This quick requires to be protected from cattle or sheep by some fence. [FENCE.] Sometimes the quick is planted in two or three parallel rows on the top of the bank, which in this case is made much wider, with a ditch on each side. A double fence in such case is necessary for its complete protection. When the quick is planted on the top of the bank, the surface sods are reserved to lay at the top; and after being broken and chopped to pieces, are dug into the bank. Stable-dung is frequently dug in at the same time, and is well bestowed: the quicks are then inserted, and well watered. They never fail to come up luxuriantly; and when properly pruned they form a close and impenetrable hedge.

Many think that it is advantageous to prune and cut down the young shoots every year, in order to excite them to throw out fresh ones in greater number. But this is an error by which the growth of the hedge is much retarded. The shoot should be allowed to grow to its full extent the first and second year; the root will then have struck deep into the ground; and in the third or fourth year the quicks may be cut down to a few inches. They will then send out several fresh and strong shoots, which may be cut and pruned to the height and width of the intended hedge.

In Holland and Flanders the hedges are often trained along stakes and rods placed for the purpose, and tied together with oziers. In this case every slender branch is tied to the rods, and they are laid so as to cross each other frequently, and the redundant shoots which cannot be conveniently tied in are cut off. These hedges, when in leaf, look very close and light, and take up very little room; and birds can scarcely harbour in them. It appears at first sight that much labour is required to train hedges in this way; but this is by no means the case. When they have once grown to the proper height, they only require to be regularly clipped.

In forming a hedge it is necessary to take into consideration the quality of the soil, the aspect of the bank, and whether the land is porous, or very retentive of moisture. In the first case it will be advantageous to plant the quick in the side of the bank, raising the earth above it to keep in the moisture. A ledge may be made by setting the first sod at a couple of inches from the edge of the ditch. The water which may fall on the bank and run down the smooth side is arrested by the ledge and soaks into the roots. In the other case the top of the bank is the proper place, and a small concavity may be given to it, to retain the water and keep the roots moist.

In a dry soil which does not require draining, ditches are unnecessary, and it is much better to plant a hedge on a little bank formed by a few sods about eighteen inches wide, with a small water-furrow on each side. The whole width need not be above two feet six inches, whereas a bank and ditch take up at least six feet, and the plough cannot go nearer than a foot from the edge of the ditch or the bank. Thus eight feet are taken up by the fence. When a hedge has been left uncut for several years, it grows wide and high. It requires to be cut down once in seven or eight years; in this case much care is required in the cutting, that the shoots may grow out again regularly. The common labourers often do this very carelessly by cutting the stems downwards with one or more cuts of their bill-hook. The consequence is that the stem is split and shivered, and the rain lodging in the ragged cut injures the wood and causes it to die down farther than it otherwise would. Hence the general maxim of 'cutting up,' so strongly recommended by all those who give directions about cutting hedges. Portions of the stems are often left of a greater length than the rest for the purpose of holding the bushes, which are generally laid over the cut stumps to protect them against cattle. But it is better to cut the hedge regularly, one row close to the ground, and one a few inches longer; this will strengthen the foot of the hedge, and prevent its becoming thin and hollow at bottom.

When a hedge has become old, and many of the plants are decayed, it is very difficult to renew it. If young quicks are planted on the same spot, they will scarcely ever succeed, unless very great precautions are taken. The soil is exhausted or deteriorated, and must be renewed: but manuring is not sufficient; fresh earth is required for the new quick. The simplest process is to level the old bank, spread the earth of which it was formed, which will be of great use to the ground where it is spread, and form a new bank in the same place from earth taken elsewhere; or, where it can be done without inconvenience, it is better to make an entirely new ditch and bank, and to fill up the old. This is perhaps the surest as well as the quickest way of having a new hedge which will be permanent.

What has been said of renewing a hedge is equally applicable to repairing gaps in an old one. It is of no use to put in young plants in the old bank. The earth must be removed, and fresh earth put in its place. The old hedge must be cut and trimmed, so that the young quick may not be shaded, and in that case the gap will shortly be filled up, and the hedge be restored as a continuous fence. Where the gaps are very small, and the hedge is not cut down altogether, it may sometimes be advisable to plant hollies or other plants, which will grow well and fill up the deficiency.

Well-managed hedges are the most effective fences, the cheapest, and the most pleasing to the eye. It is to the hedge-rows that England owes much of its garden-like appearance; but the trees, which are their chief ornament, are very destructive of the hedge as a fence; and where trees are planted it would be much better if they stood within the bank, without interfering with the hedge. Whether trees can be allowed in hedge-rows, in a perfect system of agriculture, is a question which we will not undertake to answer.

There is a method of repairing hedges which is called *plashing*. It consists in cutting half through some of the stems near the ground, and then bending the upper parts down in a horizontal or oblique position, keeping them so by means of hooked sticks driven into the bank. Thus a live hedge is made, which fills up the gaps in the same manner as a dead hedge would have done, and the bent stems soon throw out shoots. If the stems are young, and not above the thickness of a finger, an excellent hedge may be thus formed, which, when clipped, will be close and perfectly impervious. But the work is generally done in a very injudicious manner. When a hedge is plashed which has been long neglected, the thick stems, which are hacked through leaving only a small portion of the under bark uncut, have an unsightly appearance, and seldom throw out shoots near the bottom, where they are most wanted. To plash a young hedge by merely bending the twigs is an excellent practice; but when the stems are thick and old, the only remedy is to cut them down, or make an entirely new bank well planted with quick. - -

HEREFORDSHIRE AGRICULTURE.—The soil of this county consists principally of a deep heavy red loam, which varies in its degree of tenacity: in some districts there is a substratum of clay; in others gravel approaches nearer to the surface. The whole is extremely favourable to the growth of trees, especially the apple and the oak. In the neighbourhood of the towns the land here, as in most other counties, is cultivated chiefly either as meadow or pasture; in the rural parishes the quantity of land in tillage is greater, but scarcely equal to that of grass land, and the management of the land depends upon the climate and nature of the soil. The high lands, for the most part, are occupied by oak coppices, which are numerous and extensive; these are felled at periods of from sixteen to twenty years, and fetch a price of from 18*l.* to 26*l.* an acre, the bark included. In the valleys and less exposed elevations, crops are raised in the following succession:—wheat, turnips, barley, clover, wheat, and peas or vetches.—It is to the wheat crop that the farmer pays his chief attention: the two last weeks in October or the first in November are reckoned to be the best sowing time; in few counties is the seed more skilfully or neatly put into the ground. The cultivation of turnips is neither so carefully practised nor so well understood; indeed the greater part of the soil is not well suited to this crop; nevertheless it would less frequently fail if the management was more attentive and skilful; the seed is in general sown too late.

Hop-yards are common in the middle and eastern portions of the county, the hundreds of Broxash, Radlow, and Grimsworth. The bines here are planted in rows and the land ploughed, a method different from that which is practised in Kent, where they are planted on mounds and the soil cultivated with the spade.

Orchards are numerous, and not confined to any particular district. The labour of picking a quantity of apples and converting them into 110 gallons of cider may be estimated at from four to seven shillings; these form a hogshead of cider, which is sold at from 3*d.* to 2*s.* a gallon, according to the quality and abundance of the crop; in ordinary years, the price varies from 4*d.* to 1*s.* 2*d.* a gallon. An orchard of full-grown trees in good condition will sometimes produce as many as 12 hogsheads an acre.

The highest wages paid to agricultural labourers are nine shillings a week; in the northern and western parts of the county eight and seven, and in winter as little as six shillings a week are given; the addition of cider is allowed by all farmers in the summer, and by a large portion during the winter; the labourer prefers receiving a portion of his earnings in 'drink' to being paid wholly in money. The wives and families suffer from the practice, but are not generally averse to it: they think the cider a luxury due to the man for his exertion, and are ignorant of the injury they sustain. From two to four quarts of cider is the usual daily allowance; in harvest-time the quantity is unlimited, and food added to it, but the money wages are not raised; some labourers at this season will drink ten or even twelve quarts of cider in a day.

The prevalent breed of cattle is that for which this county is justly celebrated, their colour is red, with white or mottled faces, and frequently white along the back and about the legs. Good milkers are occasionally found among the cows, and it is possible that a race might be reared from this stock that would be useful for the pail, but dairy farming is never practised here, and the milk of the cows, which are kept only for the purpose of breeding, is given to the calves. It was formerly the custom to work the oxen at three and four years old, and to feed and send them to market at five, but their inefficiency as beasts of draught, the quantity of fodder consumed by the older oxen, and the slow return of capital, have caused a complete change of system: the oxen are no longer worked, but are commonly fed when they are two years old, and sent to market before they are three: their early maturity and the readiness with which they fatten make them suited for this system of farming. Graziers from the south and the middle of England drive a large number of this popular stock from the Hereford Candlemas and October fairs. The Hereford ox feeds more readily than the Devon (see 'Cattle,' 'Library of Useful Knowledge,' p. 32.): and in proportion to the quantity of food consumed lays on a greater weight of flesh than a Durham ox: the result of a trial upon this latter point may be seen in 'Cattle,' p. 34. That the flesh of the Herefords is of a finer quality than the Durhams, is proved by the superior price per stone which it obtains in Smithfield market.

The usual breed of sheep is a cross between the Leicester and the Ryeland, which is found to succeed better than the pure Leicester or South-Down; the pure Ryeland are extinct. Welsh mutton may be procured in most of the country towns. Agricultural horses of average quality are bred in considerable number. The northern part of the county bordering upon Radnorshire and Shropshire produces many useful riding and coach horses, which for some years past have been much sought after by London and other dealers: they are highly bred, compact, and active. An inferior race, fine in the bone, long in the joints, and generally with bad action, is found throughout the rest of the district. Pigs are chiefly procured from Wales, from whence a large supply of eggs and excellent poultry is sent to the market in Kington, and sold to dealers who forward them to Cheltenham, Gloucester, and other large towns.

HERTFORDSHIRE AGRICULTURE.—The climate of Hertfordshire is as mild and genial as that of most of the inland counties. The harvest is early where the soil is light and rich, as is the case in some of the valleys. On the cold wet clays, which are found in some parts of the county, and the most exposed tops of the chalky hills, the crops are later. The soil may be divided into chalk, clay, and gravel, according as each ingredient prevails; and the mixture of them forms loams of various qualities. The whole of the county is upon chalk at a greater or less depth below the soil; and in the north-western part, towards Bedfordshire, the chalk rises to the surface in considerable hills. Where the chalk lies deeper, the soil on the hills is mostly a heavy clay; and the valleys between them have variations of gravel and loam much intermixed.

The proportions of these soils are stated by Arthur Young as follows, in his view of the agriculture of Hertfordshire:—

Chalk	46,720 acres.
Clay	90,240
Loam	142,720
Rich loam . .	5,120
Poor gravel . .	17,280
Total . .	302,080

The rich loam occurs on the borders of Essex along the road from London to Bedford, and has given a greater reputation to Hertfordshire for general fertility than the average quality of the soils in the county will warrant.

The loams are generally well cultivated, but the heavy clays are capable of much improvement. Wherever the turnip husbandry prevails, the superiority of the crops is striking. The supply of manure from London gives also an advantage to the southern part of the county, where the soil is inferior and will only produce good crops by abundant manuring. Wherever the soil is not adapted to the growth of turnips, few improvements are visible. Wheat, beans, oats, and fallows, are the only varieties. Clover is much less in quantity than might be desired, and by no means so clean as it ought to be. Draining has been resorted to by some spirited proprietors and lessees; but where farms are let at rack-rent, and from year to year, as is often the case, no permanent improvement can be expected. Even if the landlord is liberal, and offers to furnish draining-tiles, the tenant has not a sufficient interest to avail himself of the offer, or to put them down in the most efficacious manner.

The number of resident gentry in Hertfordshire tends to introduce a high state of cultivation around their immediate residences; but, as the mansions are generally erected in the driest and best situations, the cold wet clays are neglected; the roads also on the clay soils are not so good; the fences are not so well kept; and a more slovenly husbandry is observed. The old heavy plough with four horses in a line may still be seen; and in some places the heavy loams mixed with flints and stones can scarcely be moved with less power: but a great improvement might be made in the construction of the plough; and effectual draining, with the use of the subsoil plough, would greatly lighten the texture, and enable lighter ploughs and fewer horses to stir them sufficiently.

Hertfordshire has been remarkable for its high banks and hedges. In many of the lanes, where two carriages could scarcely pass one another, it is difficult for a man standing on a waggon to see over the hedge. This makes the surface of the country look rich when seen from the hills, especially when there are woods and coppices interspersed amongst the fields, and many trees in the hedge-rows; but these hedges are a great impediment to the proper cultivation of the soil.

They are left to grow till the wood in them is valuable for fuel, and they are cut down more for the sake of the faggots than to keep up the fence. Hence there are many large gaps, which are stopped up by cutting half through some of the stems in the hedge, and laying them down, which is called *plashing*. [HEDGE.] Wherever the old high banks have been levelled, and neat quick hedges have been planted in their stead, and kept cut and trimmed, the ground which has been gained, together with the earth of the old banks, to mix up with lime and vegetable matters in a compost, have soon repaid the expense. The injury done by a hedge in a growth of ten or twelve years is poorly repaid by a few faggots sold to the bakers or brick-burners.

It cannot be said that there is any peculiar system of cultivation in Hertfordshire. Every system may be occasionally met with. The resident proprietors, many of whom hold considerable farms in their own hands, employ bailiffs, who come from various parts of the country, and introduce the systems which they are accustomed to; some are from Norfolk, others from Northumberland or Scotland. Before the common fields were enclosed, as they are now almost universally, a fixed rotation was unavoidable, as there were rights of pasture over certain portions of the field in what was called the fallow year; but as soon as the fields were freed from this impediment to good cultivation, each proprietor introduced his own method, whether good or bad. The consequence has been a very great difference in the crops of adjoining farms, according as they have fallen into the hands of industrious men with science and capital, or remained with those who follow the example of their forefathers. The crops are reaped as close to the ground as possible, in order that the straw may be sold in London and manure brought back in return. The corn is thrashed chiefly by hand, the straw thus produced being of greater value for horse litter. Fewer cattle are fed in winter than in more distant counties, as manure can be obtained without them.

A species of rough garden husbandry has been introduced on the best soils nearest to London for the growth of early potatoes, cabbages, peas, and other culinary vegetables, which are succeeded in the same year by other crops, the whole being forced by an abundance of manure. The plough is used, but a great portion of the labour is done by the spade and the hoe.

There are many orchards in Hertfordshire, chiefly for apples and cherries, which are sold in London. No cider is made. A good cherry-tree full-grown will give in a good year fifty dozen pounds of cherries, and occupies nine square perches of land. The grass under the trees is generally fed off. Many old orchards have ceased to be productive, although young trees have been planted where the old were past bearing. This is caused by the deterioration of the soil. But good orchards might be made by planting a succession of young trees in fresh soil, and converting old orchards into arable land. The old orchards will be admirably calculated to produce lucerne or any other valuable crop.

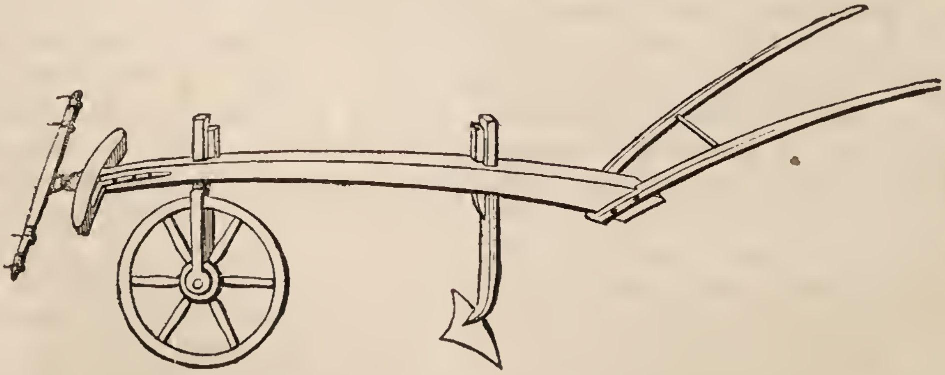
There are many woods and coppices in the poorer soils, but they are fast diminishing in number, and the land is gradually brought into cultivation as arable or pasture. They are usually cut every ninth year. Where they contain Spanish chestnut, which is valuable for hurdles and rough fences, the produce is considerable, while the timber-trees are improving in value every year; but unless they are well managed, woods do not pay a rent proportionate to the value of the land, if it were in cultivation.

There are no breeds of cattle peculiar to Hertfordshire. The Suffolk cart-horses are esteemed for farm-work, being active and tractable. Some farmers buy young horses of the black Northampton or Lincolnshire breed, which they sell again with a good profit for dray-horses in London when they are six years old. Few horses are bred in the county. The grass-lands are reserved for hay, and there are few rough pastures. A few pigs are bred, as they are on most well-managed farms: the breeds are the Essex or Berkshire, and crosses of these with the Chinese and Neapolitan, than which there are none more profitable. By judicious crossing the principal qualities of the hog may be kept up to a high degree, uniting prolific breeding with early fattening.

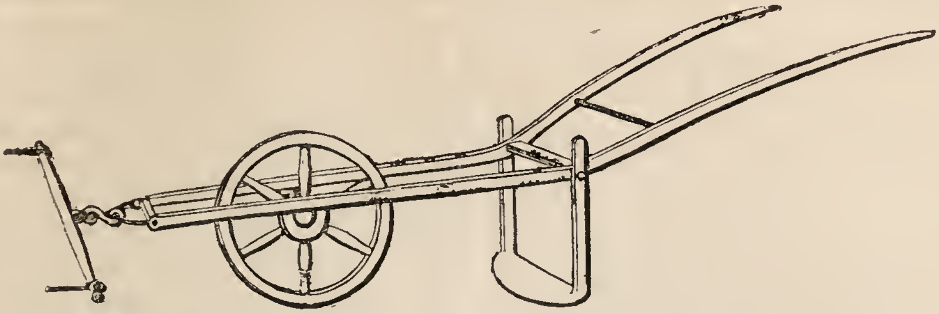
HOE, HORSE-HOEING. The hoe is an instrument used in gardens and in the fields for loosening the earth, and destroying the weeds between plants. It has various forms. The most common hoe consists of a blade or flat piece of iron, with an eye in which a handle is inserted at an acute angle with the plane of the blade. This hoe is used by striking the edge of it down into the ground, and the earth is moved by drawing the handle towards the workman. Another hoe has the handle at a very obtuse angle, and is used by pushing it forward and cutting off the weeds an inch or less under the surface of the ground. Hoes are made of different sizes and shapes, according to the work which is to be done. When the earth is to be stirred between plants which are very near each other, the hoe is narrow and pointed, so that the smallest weed may be taken out close to the growing plant. When the distance is considerable, the hoe is wide, and sometimes compounded of several hoes, in order to stir a greater width of earth at once.

One of the greatest improvements in practical agriculture has been the introduction of the hoe into the field for every kind of crop. Peas and beans were probably the first crops which were sown in rows for the purpose of hoeing the intervals; potatoes, turnips, and carrots were probably the next; and the good effects produced on these crops, by stirring and hoeing the intervals between the plants, have led to the drilling of every other kind of produce which is apt to be injured by weeds. Hand-hoeing not having been found sufficiently expeditious on a large scale, a hoe has been invented of a larger form to be drawn by a horse. The rows have in consequence been widened, and this has introduced the horse-hoeing husbandry, which, half a century ago, was thought so important a discovery as to receive the name of the New Husbandry. The great promoter of this system was Jethro Tull, a gentleman from near Hungerford in Berkshire, who having observed the good effects of stirring the soil around plants, imagined that tillage might supersede all manuring, and that by keeping the soil free from weeds, and continually stirred and pulverized, an inexhaustible fertility might be produced, and successive crops of the same kind might be raised without limit. The horse-hoe was the chief agent in this system, which imitated that of alternate crops and fallows; for the intervals between the rows in which the seed was sown were kept in a constant state of tillage, and thus fallowed for the reception of the seed for the next crop. Although these high expectations were not fulfilled, the hoeing of the intervals has caused a very great increase in the produce of the land, especially when united with judicious ploughing and manuring, and a proper succession of crops.

The simple horse-hoe is an instrument with a beam like a plough, and two stilts or handles, but much lighter; in this beam is inserted, instead of a coulter, the end of an iron hoe, of the proper breadth to stir the whole surface between the rows. A small wheel is generally added to keep the hoe at a proper depth in the soil.



A horse draws the instrument, which is held and guided like a plough. When the space to be hoed is considerable, the iron of the instrument is shaped differently. The hoe is narrower in the blade, and the instrument resembles a wheel-barrow more nearly than a plough.



From these simple instruments a variety of others have been invented of a more complicated nature, but the object of them all is the same, viz. to stir the ground between the rows, and destroy the weeds as fast as they appear.

The horse-hoe is now chiefly used in the cultivation of peas, beans, potatoes, cabbages, turnips, and carrots. It has been found that the required distance for the horse-hoe to act properly is too wide for rows of corn, and that the narrow hand-hoe is a more effective instrument in keeping these crops clean.

The effect of hoeing is remarkable in very dry weather. Although the stirring of the soil would seem to extract what little moisture there might be in it, and the weeds wither on its surface, it soon appears that, on the contrary, moisture is attracted or produced, and the plants which drooped before appear refreshed and invigorated. This is probably effected by a chemical action of the air on the vegetable portion of the soil and on the roots of the plants, which have the power of combining the gaseous principles in various ways, producing that combination of oxygen and hydrogen which forms water, while the power of vegetation in the plant itself can combine hydrogen and carbon so as to form oil and various other substances. Whatever be the mode in which it acts, experience has proved that the more the earth is stirred around plants the better they thrive.

Where a very great perfection has been attained in drilling the seed, so as to have the rows perfectly equi-distant and straight, an instrument may be used which shall hoe ten or a dozen rows at once, without danger of cutting up the growing plants. Such an instrument has been invented, but requires too great perfectino in the sowing to be very generally used. It is called the inverted horse-hoe, because the hoes are so placed as to present the back part of the hoes, which are rounded, towards the growing plants, so that even if they went so near as to touch them they would not cut them down. The points of the hoes are all in the middle of the intervals, one pointing to the right and another to the left. When the intervals are very wide, as is the case where potatoes, turnips, or cabbages grow in rows, a light plough, with one horse, going up and down the interval, answers the double purpose of a hoe and plough. It stirs the ground to a greater depth, and can be guided nearer to the growing plants than the common horse-hoe. It also turns the soil over into the middle of the interval, from which it may afterwards, when it has been improved by exposure to the air and rains, be thrown back towards the roots and stems of the plants.

The operation of hoeing cannot be performed too soon after the plant has shot out its roots, because the ground may then be stirred very near the young plant without danger, and the roots will spread readily in the newly-stirred soil.

In stiff soils it is often very difficult to use the horse-hoe, owing to the hardness of the surface, which rises in lumps, the very reverse of what is intended; but a little attention to the time of hoeing and to the weather will generally obviate this difficulty. If the soil is bound at the surface, it is a proof that the preceding tillage has not been so perfect as it ought; that the ground has not been stirred to a sufficient depth before winter, nor laid up sufficiently dry, or that it wants under-draining. There are few soils which may not be made mellow and crumbling some time or other in spring; and if the proper time be chosen for the first hoeing, the surface will scarcely ever become so compact as to rise in large clods. In the case of a very tenacious soil, the small-spiked roller [described in BEAN] may be had recourse to, and after using it a few times in dry weather, the surface will be left in a fit state for the common horse-hoe. The method usually adopted in the horse-hoeing husbandry has been taken from the common cultivation of maize, or Indian corn, in Lombardy. The rows there are about twenty-seven to thirty inches distant: as soon as the plants are out of the ground, the earth is taken from the plants and laid in a ridge in the centre of the interval; here it is exposed to the sun and rains, which, besides killing the weeds, make it much finer. In this state it is thrown back upon the plants and laid against the stems, which strike fresh roots into this mellow ground. But this will not be equally proper with all plants and in all soils. Both potatoes and cabbages are much improved by heaping up the loose soil over them; but this is not the case with many other plants. The beet, for example, while it is growing and swelling, is not benefited by having earth thrown round it; for this would induce the root to send out fibres sideways, whereas they should strike downwards in search of moisture. Turnips may be partially covered with earth from the intervals, and will be protected from the frost by this covering. By attending to the growth of any plant we may soon discover when it is advantageous to move the earth from the roots and stems, and when it is best to draw it up around them. With respect to the destruction of weeds, there can be no doubt as to its great importance to all crops. It is generally supposed that every time that wheat is hoed judiciously more than a bushel per acre is added to the crop, besides the benefit which the land receives by eradicating the weeds. Two or three good hand-hoeings will often so completely clear a field of weeds as to render superfluous the fallow which would otherwise have been necessary, and thus save all the expense of fallowing and the loss of one crop in four or five.

A great oversight is often committed when a field is hoed. The parts nearest to the fences and the sides of the banks, where the plough has not been able to go, are seldom hoed; but these parts become by neglect prolific nurseries of all kinds of weeds, which ripen their seeds, and disseminate them all over the field. No part of the surface should be left unhoed; and when the hoers leave a field, they should be able to defy any one to pick up a growing weed in it.

Those who employ labourers to hoe a field, at a certain price per acre, should be careful to see that the whole ground between the rows and the plants has been stirred; for it is a common trick to throw the earth over the growing weeds, and bury them only, without cutting them up, by which, instead of being destroyed, they flourish more vigorously.

The best time for hoeing stiff soils is when they are neither wet nor dry; when the surface is slightly caked, but there is moisture below it, and when the weather is dry after some rain. Light soils can be hoed at any time, and require it oftener than the heavy, especially in showery weather.

HOG.—The hog is one of the domestic animals which is most widely dispersed through the world, and yields to no other in its usefulness. It lives and thrives on every kind of food, vegetable or animal. It grazes like the ox, and will even eat hay; and its stomach can digest what few other animals could swallow with impunity. The sow bears two litters in the year, having from eight to twelve, and even sometimes eighteen or twenty young at a time. No animal converts a given quantity of corn or other nutritive food so soon into fat, or can be made fat on so great a variety of food.

The food of the hog in a wild state is grass, roots, acorns, beech-mast, and wild fruits. He is active and ferocious; and the boar-hunt, from the danger which attends it, is well adapted to excite those who are of a warlike disposition.

There are many varieties of the domestic hog. The brindled hog most nearly resembles the wild species; but although the flesh is savoury, he does not fatten so soon, nor is he so profitable, as the more indolent and softer skinned sorts are. The great quality of a hog is his power of digestion: the more rapidly he fattens, and the earlier he can be made to increase in flesh without increasing in bone, the better is the breed. Some of the small hogs which are brought from China are remarkable for this quality, as well as for their prolific nature; and when, by judicious crossing, the size is increased, they are a very profitable breed. The Chinese pig is short in the head, with ears pricked up and pointing backwards, very wide in the cheek, high in the chine, and short in the leg. When a sow of this breed is heavy in pig, her belly generally drags on the ground. The young pigs of the Chinese breed, especially the white variety, are excellent for roasters, at three weeks or a month old. They are small and fat, with little bone, and their skin is very delicate. They also make excellent porkers at about three months old, when kept for some time after weaning on the refuse of the dairy. They may be kept fat from the time they are weaned till they are fit to be killed for bacon; and although they do not come to a great size, they will pay very well for their food if killed at a twelvemonth old.

The breed that is nearest to the Chinese in this country is the Suffolk. They are generally white, with the ears pointed and rather forward: they are broad in the chest and loins, short and compact: they make fine bacon hogs at twelve or fifteen months old, weighing from twelve to fifteen score when killed. The sucking-pigs and porkers are also very delicate. The Essex breed is mostly black and white; the pure breed, however, is said to be quite black, and is so nearly allied to the smooth Neapolitan breed, which has scarcely any hair, that we cannot help supposing a consanguinity between them. When crossed with the Neapolitan, they produce a breed which fattens at a very early age, and to an astonishing degree. A breed of this cross, carefully selected by Lord Harborough, has gained the first prizes for fat pigs at the Smithfield annual Christmas shows for several years past. They were fed extravagantly, no doubt, but at twenty-two weeks old they were so completely covered with fat that their feet were scarcely to be seen; and if they could stand, which is doubtful, it is certain that they could not walk.

The Neapolitan hog is black, without any hair, very plump, with pricked ears. No breed can excel it in the aptitude to fatten. The sows often become so fat on very scanty food, that they will not breed: they are extremely tender; and if they happen to have litters in winter, it is difficult to save the young pigs from dying in cold nights. A cross of the Neapolitan with some of our hardier breeds greatly improves their usefulness, without injuring their aptitude to fatten: the best cross is with the Berkshire, which is a very well shaped hog, with short legs, small ears, broad chines and loins, and good hams.

From the prolific nature of the hog, it is not difficult to select the best individuals to breed from. In every litter there will be pigs better formed than the generality, and by careful selection of these any breed may be soon much improved without crossing; but experience teaches that when the sows and boars are too nearly related the fecundity gradually diminishes; and by continually breeding from the same stock the sows at last produce only two or three diminutive pigs at a litter. Hence the advantage of frequent crossing. To restore fecundity no breed is so effectual as the Chinese. A breed compounded of the Berkshire, Chinese, and Neapolitan may, by careful selection, produce every quality which can be desired; numerous litters, early fatting, and fine hogs for bacon at twelve or sixteen months old, are the result of care and judicious breeding.

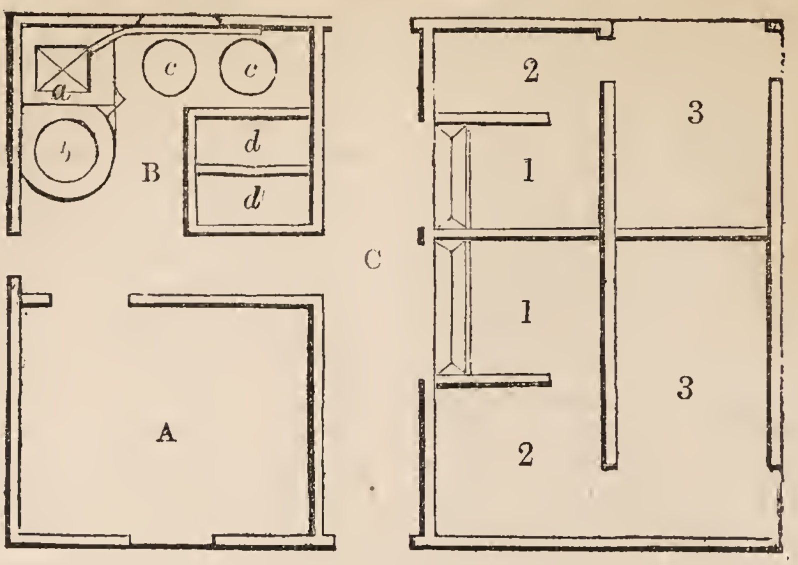
The black hogs are preferred on the whole. They are much less subject to diseases of the skin than the white, and the sun affects them less in summer. For sucking pigs or porkers many prefer the white, merely for the appearance; for the black skin is in general the finest.

There are some very large breeds, which have been recommended under the idea that in a large hog the bone and offal are less in proportion to the flesh than in a smaller. But these large breeds do not come so soon to maturity. They cannot be profitably put up to fatten till eighteen or twenty months old, or more; and although some of them may make hogs of thirty or forty score when killed, they are so long fatting, and require so much food, that it is very doubtful whether they pay for it as well as the smaller. For delicate bacon the hogs killed at a twelvemonth old, and weighing ten or twelve score, are much preferred: and we are inclined to think that they are most profitable. When hams are the principal object, the hogs should be killed before they are so fat as they might be; and the carcass is then cut up and pickled, instead of being converted into dry bacon. To keep hogs profitably, a regular system should be pursued both in the breeding and feeding. Proper hogsties should be constructed, with chambers in which the pigs of different ages and the breeding-sows may be kept separate. The food should be prepared for them by boiling or steaming in an apparatus conveniently placed, and the greatest cleanliness and regularity should be maintained. It is a great mistake to suppose that the hog loves dirt. If he can keep himself clean he will do so; and the wallowing in the mud is not from a love of dirt, but from a heat and itching in the skin in warm weather, which is relieved by rolling in the cool mud. If hogs have plenty of clean straw and clean water they never will be dirty, and nothing makes them thrive so quick or pleases them more than being washed and curried regularly. If the hogs are not closely confined they will always lay their dung at a distance from the place where they sleep or feed, and in all well-constructed sties there should be a small yard to each apartment, in which the hogs can deposit their dung.

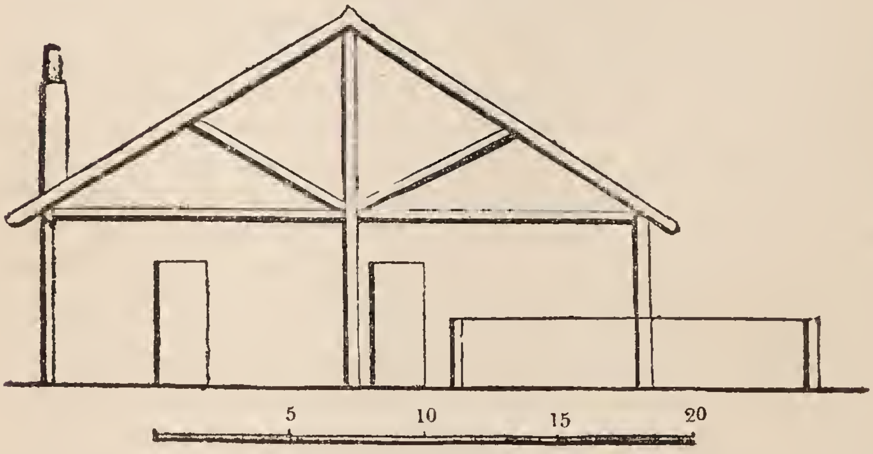
When a sow is near the time of farrowing, which is four months after she has taken the boar, she should be put in a sty by herself, with a moderate quantity of straw, for if there be too great an abundance she is apt to lie down on the young pigs when they bury themselves in the loose straw. Sows, although very careful of their pigs, are very apt to lie on them, especially when any of them are near a wall: to prevent this, it is very useful to have a ledge of wood six inches wide and six inches from the ground all round the stye, so that she cannot lie down close to the wall; and if a young pig should be accidentally behind her, he can take refuge behind the ledge, and thus escape being lain upon. When no precautions are taken, one-fourth of a litter is often lost in the first day or two after they are born. Some sows have the unnatural propensity of eating their young pigs as soon as they drop: good feeding will prevent this in some measure, but attention at the moment of farrowing is the safest and surest preventive. When once the young pigs have sucked, much of the danger is past.

A sow with many pigs should be well fed; bran and barley-meal with milk or whey is the best food; grains, where they are at hand, are excellent; and it is useful to let the sow go out to graze in a meadow or clover-field for an hour or two every day, shutting up the pigs during that time till they are a fortnight or three weeks old, when they may then accompany the sow. A sow will live many years, and bring numerous litters, and the older she is the better nurse she is in general. When a sow has ten or twelve pigs at a litter, and two litters in the year, one in spring and another in autumn, she is too valuable to be killed, and ought to be kept as long as she will breed. But otherwise it is very profitable to let a young sow have a litter at ten months old, and spay her immediately: she will then fatten most readily as soon as the pigs are weaned; and the bacon will be as good as that of a maiden pig. Whenever a sow does not bring a sufficient number of pigs, or is not a good nurse, or has ever eaten any of her pigs, she should be spayed and fattened immediately. The young pigs intended to be kept for stores or for porkers are castrated or spayed at a month or six weeks old. The males are then called *barrow* pigs, and when fatted make the best bacon. They are usually put up at a twelvemonth old and fatted in three or four months. At first they have potatoes raw or boiled, mixed with bran, or bean-meal, or they have dry beans and water. After they are half fat they should only have peas-meal or barley-meal and water, unless in a dairy, where they have the skimmed milk or whey. Hogs fattened on potatoes only do not make so good bacon as those which are fatted on corn. This is the reason why the home-cured bacon sells so much dearer than the Irish. When a piece of raw bacon is put into the pot and swells in the boiling, it is a sure sign that the hog has been well fed; if it shrinks, it may be concluded that he has been fattened chiefly on potatoes. The labourers in the country, who live chiefly on bacon, know this well, and always purchase the best-fed bacon, even at a much higher price, finding it most economical. Potatoes are an excellent food for store pigs, and may be given boiled and mixed with meal in the early part of the fatting process; but beans and peas make the firmest flesh, and barley-meal the sweetest. Before a hog is killed he is usually fed for some time on barley-meal and water alone, given as thick as porridge, and very little, if any, water is given to him. This last rule is often carried to too great an extent. Much water will make the food pass through too rapidly, and it will not be digested, but the hog should never suffer from thirst, or he will not thrive. Before a hog is killed he should be kept without food for twelve hours at least: he may, however, have water. He should be killed without giving him more pain or causing more struggling than is necessary, by a resolute stab with the knife in the lower part of the neck, where the knife may sever the large artery which comes directly from the heart. The blood should be allowed to flow freely till it is all out of the body. The hog, if intended for salt pork, must then be scalded with water not quite boiling, and well scraped, to take off the hair with the cuticle; but for bacon it is best to singe the hair by burning straw over the body, and then scraping the skin. Care must be taken not to allow the skin to be burnt so as to crack. The hog is then hung up, and the entrails taken out. The inside of the body is washed clean with a cloth or sponge dipped in water, that no blood may remain, and the next day the hog is cut up. The head and feet are cut off; the chine is taken out, and the upper part of the ribs, with the backbone, are cut out, leaving as much flesh as possible adhering to the fat outside. The small ends of the ribs remain attached to the bacon. The curing of bacon has been described. [HAMPSHIRE AGRICULTURE.]

Hog-sty.—Much of the profit of breeding and fattening hogs depends on the economy of labour in preparing their food. Any place is often thought good enough to lodge a pig in, and a sty is a word synonymous with a filthy place. But in every well arranged farm-yard there should be a convenient place for keeping hogs and feeding them, which may be erected at a small expense, and which will soon repay the outlay. There should be a place to boil and mix the food in, with one or more large coppers and a steaming apparatus. The food should be mixed in square brick tanks sunk in the ground and cemented, that there may be no filtrations. If there is only one tank, there should be a partition in it. From the boiling-house there should be an immediate communication with the feeding-sties, under cover, if possible. Each sty should open into a small yard behind, which should communicate by a door with the principal farm-yard, where the barn is situated in which the corn is thrashed, and be enclosed with a low wall or paling. There should be separate sties for breeding-sows, for porkers, and for fatting hogs. Not more than three or four of the latter should be in one sty: the food should be given in troughs, in a separate compartment from that in which the hogs lie down, and no litter should be allowed there. The floor, which should be of brick or stone, should be frequently washed clean, and the troughs should be cleaned out before every meal; any of the food left from the last meal should be taken out and given to the store-pigs. A very convenient contrivance for keeping the troughs clean is to have a flap or door, made with hinges, to hang horizontally over the trough so that it can swing, and alternately be fastened by a bolt to the inside or outside edge of the trough. When the hogs have fed sufficiently the door is swung back, and the trough is easily cleaned out. It remains so till feeding-



Elevation and Section.



SCALE OF FEET.

A, Root-house ; B, boiling and steaming-house ; *a*, steamer ; *b*, copper ; *c*, *c*, steaming vessels ; *d*, *d*, tanks to mix the food ; C, passage to the sties ; 1, 1, feeding-rooms ; 2, 2, sleeping-rooms ; 3, 3, yards.

time, when the food is poured in without any impediment from the greedy hogs, who cannot get at it till the door is swung back. This simple contrivance saves a great deal of trouble, and is easily adapted to any common sty. It is a great advantage to be able to inspect the sties without going into them, and this is effected by placing them under a common roof, which may conveniently be a lean to the boiling-house or any other building, with a passage between them.

The preceding figure will best explain this, and show its superiority over common sties.

HOPS (Humulus lupulus of Linnæus) are extensively cultivated for the flowers or seed-vessels, which give flavour and permanence to beer, by being boiled with the wort in brewing. They impart a pleasant bitter and aromatic flavour, and prevent the too rapid progress of fermentation. Beer which is well hopped will keep long and become very fine, without any of those artificial means of fining which make the common brewers' beer so much inferior in quality to that which is home-brewed.

Hops were introduced into England from Flanders about the year 1524. The most extensive plantations are in Kent, Sussex, and Herefordshire ; but they are also cultivated in Worcestershire, Wiltshire, Hampshire, Gloucestershire, Surrey, and several other counties. The hop is a slender climbing plant, which requires a very rich mellow soil and careful cultivation. It is very tender, and the produce is precarious, sometimes giving a great profit to the grower, and at other times failing altogether. The greatest quantity of hops is raised in Kent, but the finest quality in the neighbourhood of Farnham in Surrey. The soil of a hop-garden must be rich to a considerable depth, or made so artificially. The subsoil must be dry and sound; a porous rocky subsoil, covered with two or three feet of good vegetable mould, is the best for hops. The exposure should be towards the south, on the slope of a hill, or in a well-sheltered valley. Old rich pastures make the best hop-gardens. They should be dug two or more spits deep, and the sods buried at the bottom, where they will gradually decay and afford nourishment to the slender roots of the plants which strike deep. A very large quantity of the richest rotten dung, at least 100 cubic yards per acre, should be well incorporated with the soil by repeated ploughings, till it is entirely decomposed and produces that dark tint which is the sure sign of an abundance of humus. The ground should be prepared by laying it up with the spade in high ridges before winter, to expose it as much as possible to the mellowing influence of the frost. A succession of green crops, such as rye cut green or fed off with sheep, early turnips fed off in autumn, or spring tares, are an excellent preparation, by cleaning the land. It is better to be two or even three years in preparing the ground and getting it perfectly clean, than to plant the hops in a foul or unprepared soil.

The young plants are raised in beds, and may be raised from seed; but it is more usual to plant the young shoots which rise from the bottom of the stems of old plants. They are laid down in the earth till they strike, when they are cut off and planted in the nursery-bed. Care must be taken to have only one sort of hops in a plantation, that they may all ripen at the same time; but where there are very extensive hop-grounds it may be advantageous to have an earlier and a later sort in different divisions, so that they may be picked in succession. The varieties most esteemed are the Grape Hop, the White Vine, and the Golden Hop. The ground having been prepared for planting, it is divided by parallel lines, six or more feet apart, and short sticks are inserted into the ground along these lines at six feet distance from each other, so as to alternate in the rows, as is frequently done with cabbage-plants in gardens. At each stick a hole is dug two feet square and two feet deep, which is filled lightly with the earth dug out, together with a compost prepared with dung, lime, and earth, well mixed by repeated turning. Fresh dung should never be applied to hops. Three plants are placed in the middle of this hole six inches asunder, forming an equilateral triangle. A watering with liquid manure greatly assists their taking root, and they soon begin to show bines. A stick three or four feet long is then stuck in the middle of the three plants, and the bines are tied to these with twine or the shreds of Russia mats, till they lay hold and twine round them. During their growth the ground is well hoed and forked up around the roots, and some of the fine mould is thrown around the stems. In favourable seasons a few hops may be picked from these young plants in the autumn, but in general there is nothing the first year. Early in November the ground is carefully dug with the spade, and the earth, being turned towards the plants, is left so all the winter.

In the second year, early in spring, the hillocks around the plants are opened, and the roots examined. The last year's shoots are cut off within an inch of the main stem, and all the suckers quite close to it. The suckers form an agreeable vegetable for the table, dressed like asparagus. The earth is pressed round the roots, and the cut parts covered so as to exclude the air. A pole about twelve feet long is then firmly stuck into the ground near the plants; to this the bines are led and tied as they shoot, till they have taken hold of it. If by any accident the bine leaves the pole, it should be carefully brought back to it, and tied till it takes hold again. A stand ladder should be at hand to do this, when the bine has acquired some height. The ground being well hoed and the earth raised round the plants, the produce this year will average 4 cwts. per acre, if the season is favourable.

Some hop-planters plough up or dig the ground before winter; others prefer doing it in spring, in order not to hasten the shooting, which weakens the plants. The same operations of pruning the shoots, manuring, and placing poles, which were performed the preceding year, are carefully repeated. Particular attention is paid to proportion the length of the poles to the probable strength of the bines; for if the pole is too long, it draws up the bine, and makes it bear less; if it is too short, the bines entangle when they get beyond the poles, and cause confusion in the picking. In September, the flower containing the seed will be of a fine straw colour, turning to a brown; it is then in perfection. When it is over-ripe it acquires a darker tint. No time is now lost, and as many hands are procured as can be set a-picking; great numbers of men and women go out of the towns in the hopping season, and earn good wages in the hop plantations. During the picking they sleep in barns and outhouses. In the picking, the poles are taken down, and the stems cut three feet from the ground; if they were cut shorter it would weaken the root, by causing it to bleed. The poles are laid sloping over a frame of strong wood nine feet long and four feet wide, supported by legs three feet high; this is called a bin. A piece of coarse cloth is fixed to this frame by hooks, so as to form a bag, which does not reach the ground. Three men or women, or four boys or girls, are placed on each side of the bin, and pick the hops from two poles at a time. Where they are very careful of the quality of the hops, as at Farnham, they divide them into three sorts: the green, which are not quite ripe; the light yellow-brown, which are in perfection; and the very dark, which are past their prime. Some go even further, and make several qualities according to colour and fragrance: for this purpose there are several baskets. The dew should be off entirely before they begin; for otherwise the hops might become musty, or take too long drying, and lose their fragrance. The hops when picked are dried on a hair cloth in a kiln. When they appear sufficiently dry at bottom they are turned; it is however thought by some hop-driers that the turning of the hops is apt to injure them, and that it is best not to do so; but in order that the upper part may be dried equally with the lower, a wooden cover lined with tin plates is let down over the hops on the hair cloth, to within a few inches of the surface; this reverberates the heat, and the whole is dried equally. The heat must be carefully regulated, in order that it may not alter the colour. When the leaves of the hops become brittle and rub off easily, they are sufficiently dried. They are then laid in heaps on the floor, where they undergo a very slight heating. As soon as this is observed, they are *bagged*. This is done through a round hole 25 or 30 inches in diameter, made in the floor of the loft where the hops are laid. Under this hole is a bag, the mouth of which is drawn through the hole, and kept open by a hoop to which it is made fast. The hoop is somewhat larger than the hole, and the bag remains suspended; a handful of hops is now put into each corner of the bag, and there tied firmly by a cord. A bushel or two of hops are put into the bag, and a man gets into it to tread the hops tight. The bag does not reach the floor below. As the hops are packed by the feet, more are continually added till the bag is full. It is now taken off the hoop, and filled up with the hands as tight as possible. The corners are stuffed as soon as the mouth is partly sewn up, and tied as the lower corners were; when sewed close and tight, it is stored in a dry place till the hops are wanted for sale.

The crop of the third year will average 8 cwt. per acre. In some very extraordinary seasons, on good land, 15 cwt. have been picked per acre: in Flanders, where they manure with urine and the emptyings of privies, this is not an uncommon produce.

Rape-cakes, malt dust, and woollen rags are used with good success in hop-grounds: bones have been tried, but with an uncertain result.

The hop is a diœcious plant, *i. e.* some of the individuals are male plants and others female, which have respectively flowers of a different construction and of different habitudes. The male or staminiferous flowers, which grow on stalks quite distinct from the female flowers, prepare the pollen, or fertilizing dust, and afterwards wither away, when this dust has escaped from the anthers, and been committed to the air, to be by it conveyed to the female flowers. The female flowers are in the form of strobuli, or cones, consisting of scales, which have at their base the germ of the future seed, and which have the habit of enlarging, as the scales of the fir-cones do, more particularly after the fertilization of the ovule, or future seed, by a quantity of the pollen falling upon it.

Though the pollen, from its extreme lightness, can be wafted to a considerable distance, and some seeds in each cone may be so fertilized, yet it would be well to rear a number of the male plants among the others, or along the hedges of the hop-gardens, to ensure the fertilization of *all* the seeds. But as the farmers observe that the flowers of the male (termed, in Kent, seedling, blind, or wild hop; in Sussex, buck or cock hop) wither away, they generally extirpate them at the digging season, as unfruitful cumberers of the ground. That this is an error may be proved in various ways, but an appeal to the result of an opposite practice is the most convincing. A bushel of hops, collected from plants of the fourth year, raised from seed, weighed 36 pounds, there being male plants near; a second instance, where the plants were raised from cuttings, weighed thirty-five pounds; while a bushel, grown in a garden where the male plants were always eradicated, weighed only 22 pounds. Besides the greater quantity of hops thus obtained, the aroma is much greater (the *lupulin*, on which the aroma depends, is considered by Planché to be the unappropriated pollen dust which has alighted on the scale of the females), and the strength of the bitter much greater. After the period when the males have elaborated the pollen, and the strobuli of the females begun to enlarge, the males may be cut down, and the stalks employed to make cordage for hop-bags against the following harvest. In 1760 the Society of Arts awarded premiums for cloth made from the hop-bine. (Lance's *Golden Farmer*, London, 1831.)

The poles are an expensive article; those of chestnut are the most durable, and also the dearest. They should be put into a shed during winter: where this cannot be done, they are placed on end in the form of a cone, leaning against each other. If the tops of these cones had a cap of thatch, it would greatly protect them from the weather: whether it will be worth while to soak them in a solution of corrosive sublimate, according to Kyan's patent, remains yet to be proved; but if it should preserve them, every extensive hop-grower should have a tank for the purpose.

HORSE.—*Natural History and Dentition of the Horse.*—The native country of the horse is unknown. From very remote periods he has been found in almost every part of the Old World, but his appearance on the continents and the islands of the New World, whether of the Atlantic or Pacific Ocean, is of comparatively recent date. Everywhere he is recognised as the most useful of the servants of man, and he yields in intelligence to the dog alone. In the earlier ages of the world he seems to have been devoted to the purposes of war or of pleasure, while the ox was our agricultural servant; but his beauty and strength and tractability have now connected him, directly or indirectly, with almost all the purposes of life. If he differs in different countries in form and in size, it is from the influence of climate and cultivation; but otherwise, from the war-horse, as he is depicted on the friezes of antient temples, to the stately charger of Holstein and of Spain, or from the fleet and beautiful Arabian to the diminutive Shetlander, there is an evident similarity of form and destination which clearly stamps his common origin.

He is naturally and of choice an herbivorous animal. His thin and muscular lips, his firm and compressed mouth, and his sharp incisor teeth, are admirably adapted to seize and to crop the grass;

and although we know nothing of him in his natural state, yet when he has escaped from the bondage of man, and follows his own propensities, the grass is his chosen food. In his domesticated state, however, he was destined to live partially or chiefly on other aliment, and that of a much harder kind—the various species of corn; therefore while man and the carnivorous animals can only champ and crush their food, a provision is given to the horse, in the structure of some of the bones of the face, by means of which he can comminute and grind down his food as perfectly as in the best-contrived mill.

The teeth of the horse require some lengthened consideration, not only from their admirable adaptation to this purpose, but as indicating, by the various changes which they undergo, almost beyond the possibility of error, the age of the animal. He may, when young in years, be reduced nearly to the decrepitude of age by the barbarous usage of those who ought to be his most zealous protectors; the cavity above the eye may be deepened, the under lip may fall, the limbs may be bowed, and the feet may be battered and distorted,—but it is not easy to alter the character of the teeth.

The colt is generally dropped with the first and second molar and grinding teeth having forced their way through the gum. When he is about seven or eight days old the two central front or incisor teeth, above and below, appear. At the expiration of five or six weeks the two next incisors may be seen. At three months they will have overtaken the central ones, and both pairs will have nearly attained their natural level. A third grinder will then have appeared; and a little before or after the eighth month the third nipper, above and below, and on each side, will be seen. The colt will now have his full compliment of front or cutting teeth.

These teeth are beautifully adapted to their purpose. They have in front an elevated cutting edge of considerable sharpness. It is formed of enamel, a polished substance almost too hard to be acted upon by the file, which covers the tooth. This elevated edge is bent somewhat inwards and over the tooth, so that there is a depression behind it which gradually becomes stained by the food, and constitutes what is called 'the mark' in the mouth of the colt or horse.

This elevated edge of enamel, hard as it is, is gradually worn down in the act of nipping and cutting the grass; and as it wears away, the hollow behind becomes diminished, and is at length totally obliterated. By the degree in which this mark is effaced, the horseman, not only with regard to the first, but the permanent teeth, judges of the age of the animal. This obliteration begins to be manifest at a very early age. At six months it is sufficiently evident in the four central nippers. At a year and a half the mark will be very faint in the central nippers, diminished in the other two, and the surface of all them will be flattened.

At twelve months a fourth grinder protrudes, and a fifth at the expiration of two years.

These are all temporary teeth. They were only to last during a very early period of the life of the animal; and when his jaws were considerably expanded, they were destined to give way to another set, larger, firmer, and that would probably last during life. The permanant teeth had been long growing in the socket beneath the temporary ones, and had been pressing upon their roots, and that pressure had caused an absorption of these roots, until at length they lost all hold and were displaced.

When the animal is about three years old the central pair of nippers, above and below, are thus removed, and two fresh teeth, easily distinguishable from the first by their increased size, make their appearance, so that a three-year-old colt is easily recognised by these two new and enlarged central nippers.

A three-year-old colt has his form and energies much more developed than a two-year-old one, and is considerably more valuable; therefore some dishonest breeders endeavour to pass him upon the unwary as being a year older than he really is, and they accomplish this in an ingenious but cruel manner. This cannot however be effected until a portion of the second year is past, when the permanent teeth below are beginning to press upon the roots of their predecessors, and then the breeder extracts the central milk-teeth. Those below, having no longer anything to resist their progress, grow far more rapidly than they otherwise would do, and the scoundrel gains four or five months in the apparent age of his colt.

Can this trickery be detected? Not always, except by him who is well accustomed to horses. The comparatively slow wasting of the other nippers, the difference of the development of these nippers in the upper and under jaw—for the breeder usually confines his roguery to the lower jaw, the upper one being comparatively seldom examined—these circumstances, together with a deficiency of general development in the colt, will alone enable the purchaser to detect the attempted cheat.

The honest mouth of a three-year-old horse should be thus formed:—the central teeth are palpably larger than the others, and have the mark on their upper surface evident and well defined. They will, however, be lower than the other teeth. The mark in the next pair of nippers will be nearly worn away, and that in the corner nippers will begin to wear.

At three years and a half the second nippers will be pushed from their sockets, and their place gradually supplied by a new pair; and at four and a half the corner nippers will be undergoing the same process. Thus at four years old the central nippers will be fully grown; the next pair will be up, but will not have attained their full height; and the corner nippers will be small, with their mark nearly effaced. At five years old the mark will begin to be effaced from the central teeth, the next pair will be fully grown and the blackness of the mark a little taken off, and the corner pair will be protruding or partly grown.

At this period, or between the fourth and fifth year, another change will have taken place in the mouth; the tushes will have begun to appear. There will be two of them in each jaw, between the nippers and the grinders, considerably nearer to the former than the latter, and particularly so in the lower jaw. The use of these tushes in the domesticated state of the horse is not evident; but they were probably designed as weapons of offence in the wild state of the animal. Attempts are too frequently made to hasten the appearance of the second and the corner teeth, in the same manner as described with regard to the first, and the gum is often deeply lanced in order to hasten the appearance of the tush.

At six years old the mark on the central nippers will be diminished, if not obliterated. A depression and a mark of rather brown hue may remain, but the deep blackened hole in the centre will no longer be found. The other incisors will also be somewhat worn, and the tush fully developed.

At seven the mark on the next pair of incisors will have nearly disappeared, and the tush will be rounded at the point and the edges.

At eight the mark will have disappeared from all the incisor teeth, and the tush will be evidently rounder and blunter.

At this period another piece of trickery is occasionally practised. The breeder had, till the animal was five years old, been endeavouring to give him an older appearance than his years entitled him to, because in proportion as he approached the period when his powers was most perfectly developed his value increased; but now he endeavours to conceal the ravages of age. The horse is cast, and with a sharp-pointed steel instrument a little hole is dug on the surface of the corner incisor, to which a red-hot iron is afterwards applied. An indelible black mark is thus left on the tooth. Sometimes the roguery is carried further; the next tooth is slightly touched with the engraver and the cautery; but here the dishonest dealer generally overreaches himself, for the form and general appearance of a six-year-old horse can rarely be given to one who has passed his eighth year. The eighth year having passed, it is difficult to decide on the exact age of the horse. The incisors of the upper jaw are then the best guides. At nine years the mark is said to be worn away from the central teeth; at eleven, from the next pair; and at twelve, from the corner ones. The tush likewise becomes shorter and blunter.

There are many circumstances which render a decision as to the age of the horse very difficult after the marks are effaced from the lower incisors, and even before that period. Horses always kept in the stable have the mark much sooner worn out than those that are at grass, and it is impossible to form any calculation at all as to crib-biters.

Of the age to which the horse would naturally arrive it is impossible to say anything satisfactory. Many have exceeded thirty, and some of them even forty years; but, from ill-usage and over-exertion, the majority come to their end before they have seen nine or ten years.

The Proper Conformation of the Horse.—A very general account only can be given of this, for it varies essentially with the breed and destination of the animal. There are some points however which are valuable in horses of every description. The head should not be disproportionally large, and should be well set on, *i. e.* the lower jaw-bones should be sufficiently far apart to enable the head to form that angle with the neck which gives free motion and a graceful carriage to it, and prevents its bearing too heavy on the hand. The eye should be large and a little prominent, and the eyelid fine and thin. The ear should be small and erect, and quick in motion. The lop-ear indicates dullness or stubbornness; and when it is habitually laid too far back upon the neck, there is too frequently a disposition to mischief. The nostril in every breed should be somewhat expanded: it can hardly be too much so in the racer, the hunter, the roadster, and the coach-horse, for this animal breathes only through the nostril, and would be dangerously distressed when much speed is required of him, if the nostril could not dilate to admit and to return the air. The neck should be long rather than short. It then enables the animal to graze with more ease, and to throw his weight more forward whether he is in harness or galloping at the top of his speed. It should be muscular at its base, and gradually become fine as it approaches the head. The withers should be somewhat high in every horse, except perhaps that of heavy draught, and it does not harm him, for there is larger surface for the attachment of the muscles of the back, and they act at greater mechanical advantage. A slanting direction of the shoulder gives also much mechanical advantage, as well as an easy and pleasant action, and a greater degree of safety. It must not, however, exist in any considerable degree in the horse of draught, and particularly of heavy draught. The chest must be capacious, for it contains the heart and the lungs, the organs on which the speed and endurance of the horse depend. Capacity of chest is indispensable in every horse, but the form of the chest admits of variation. In the waggon-horse the circular chest may be admitted, because he seldom goes at any great speed, and there is comparatively little variation in the quantity of air required; but in other horses the variation is often fearful. The quantity of air expended in a gallop is many times that required in hard work. Here we must have depth of chest, not only as giving more room for the insertion of the muscles on the action of which the expansion of the chest depends, but a conformation of the chest which admits of that expansion. That which is somewhat straight may be easily bent into a circle when greater capacity is required; that which is already circular admits of no expansion. A few words more are all that our limits permit us to add, and they contain almost all that is necessary to be added on the conformation of the horse. “The loins should be broad, the quarters long, the thighs muscular, and the hocks well bent and well under the horse.”

General Management of Horses.—The foal, as soon as it is dropped, should be turned with its dam into a sheltered and good pasture, in which there is a hovel for occasional retreat from the wind and the rain. Some hay or corn, or both, should be allowed, if it is early in the season, or the grass has scarcely begun to shoot. There is nothing so detrimental to the colt as insufficient food. It should be regarded as a fundamental principle in breeding, that if the growth is checked by starvation, beauty and energy and stoutness will rarely be displayed in after-years.

In five or six months, according to the growth of the foal, or the convenience of the farmer, the weaning may take place. The colt should be removed from his former haunts to some distant rick-yard, or confined to a stable, until he becomes a little reconciled to the loss of his dam.

In the ensuing spring the *breaking* may commence; a process on which will materially depend the temper and the value of the horse, and the pleasure of the rider. The foal should be handled and haltered, and led about by the servant who has the chief care of him, and whose conduct towards him should always be kind. "The principle," says the author of 'The Horse,' "on which the after-usefulness of the animal is founded, is early attachment to and confidence in man, and obedience, resulting principally from these."

With regard to the racing colt, the processes of breaking and training are injuriously and cruelly completed in the second year, and thousands of horses are irreparably injured by this early exaction of labour and speed: but in the hunter, the hackney, the agricultural and the carriage horse, the serious part of this business is not entered upon until the third year.

A horse is well broken when he has been taught implicit and cheerful obedience to his rider or driver, and dexterity in the performance of his work. A dogged, sullen, spiritless submission may be enforced by the cruel and brutal usage to which the breaker so frequently has recourse; but that prompt and eager response to the slightest intimation of the rider's will—that manifest aim to anticipate every wish, that gives to the horse so much of his value, must be built on habitual confidence and attachment. The education of the horse should be that of a child. Pleasure should be as much as possible associated with the early lessons; while firmness, or, if need be, coercion, must establish the habit of obedience.

The breaking being accomplished, the management of the horse will vary according to his breed and destination; but the good usage of our domesticated slaves should be regarded as a principle that ought never to be violated. The agricultural horse is seldom overworked, and on large farms is generally well fed; perhaps, in many cases, too much above his work. This however is an error on the right side. A very slight inspection of the animal will always enable the owner to determine whether he is too well or not sufficiently fed. The size of the horse and the nature of the work, and the season of the year, will make considerable difference in the quantity and quality of the food. The following accounts will sufficiently elucidate the general custom: "Mr. Harper, of Bank Hall, Lancashire, ploughs seven acres per week, the year through, on strong land, with a team of three horses, and allows to each weekly two bushels of oats, with hay, during the winter six months, and during the remainder of the year one bushel of oats per week, with green food. Mr. Ellman, of Glynde in Sussex, allows two bushels of oats, with peas-haulm or straw, with but very little hay, during thirty winter weeks. He gives one bushel of oats with green food during the summer."* There is very little difference in the management of these two gentlemen, and that probably arising from circumstances peculiar to their respective farms. The grand principles of feeding with reference to agricultural horses are, to keep the animal rather above his work, to give him good and wholesome food, and, by the use of the nose-bag, or other means, never to let him be worked more than four or five hours without being baited.

The horse of quick work, the stage-coach horse and the poster, should be allowed as much as he will eat, care being taken that no more is put into the manger than he will readily dispose of. The quantity actually eaten will depend on the degree of work and the natural appetite of the horse, but it may be averaged at about 66 pounds of chaff, 17½ pounds of beans, and 77 of oats per week. When the work is unusually hard, the quantity of oats may be diminished, that of beans increased, and a portion of barley added.

During the sporting season the hunter is well fed, and with that kind of food which contains a great proportion of nutriment in little compass. A small quantity of hay, rarely more than eight or ten pounds per day, is allowed, and less than that on the day before work. The quantity of corn may vary from 14 to 16 lbs. daily. There is a prejudice in most hunting stables, and probably well founded, against chaff, and it is seldom that the beans and oats are bruised. A bran-mash is given after a day of more than usual fatigue, and is serviceable at other times, when there has not been more than ordinary work, provided that at least two days are suffered to elapse before the horse is again taken into the field.

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* 'Agricultural Survey of Sussex,' pp. 378 and 381.

No horse should be urged on after he has exhibited unequivocal symptoms of distress, such as a drooping pace, a staggering gait, a heavy bearing on the hand, a rapid inspiration like a hurried sigh, and a peculiar convulsive action of the diaphragm, as though the heart were violently beating against the side. The loss of blood, the administration of some cordial medicine, and slow leading to the nearest stable, are the best restoratives at the moment of distress; although the cordial would be absolutely destructive a few hours afterwards, when inflammation had commenced.

The hunting season having passed, the horse used to be turned into the field as soon as the grass had begun fairly to sprout, and there, with his feed or two feeds of corn daily, and his hovel, into which he might retreat from the sun or the storm, he remained until the middle of June, or the flies began to be troublesome. It was delightful to see how much he enjoyed this short period of liberty; and well had he earned it. Of late years however it has become the fashion to confine him to his box, whence he stirs not except for an hour's walking exercise on the road, until he is taken into training for the next winter's business.

Nothing can be so erroneous or cruel as this. There are few horses that have not materially suffered in their legs and feet before the close of the hunting season. There cannot be anything so refreshing to their feet as the damp coolness of the herbage which they tread at that period, and there is no physic which so safely and effectually as the spring grass carries off every humour that may be lurking in their frame.

The training of the hunter for his work is a simple affair. It is, by means of exercise and physic, getting rid of all superfluous fat and flesh, without debilitating him. The physic is useful; it is indispensable; but the chief thing is gradually to accustom him to the exertion of every power that he possesses, without too much hurrying his breathing or overstraining or injuring him.

The training of the race-horse is of a similar character, but it is far more severe, for his strength, his speed, and his endurance must be tested to the utmost. The hunter has to carry his rider gallantly and well through perhaps a long burst, and if he tires, and the sportsman has the good sense and humanity to cease to urge him on, the greatest evil is some temporary suffering to him, and disappointment to his master; but if the race-horse breaks down, or if his capabilities have not been accurately calculated, the most serious loss may be sustained. Thence arises the necessity of straining and of testing every power in the preparation of the turf horse; and thence too it happens, from the strange and impolitic sacrifice of the endurance of the modern racer to speed during short distances, that so many young horses break down and become perfectly useless in their training.

The *watering* of the horse is a very important but disregarded portion of his general management. The kind of water has not been sufficiently considered. The difference between what is termed *hard* and *soft* water is a circumstance of general observation. The former contains certain saline principles which decompose some bodies, as in the curdling of soap; and prevent the solution of others, as in the making of tea, the boiling of vegetables, and the process of brewing. It is natural to suppose that these different kinds of water would produce somewhat different effects on the animal frame, and such is the fact. Hard water, freshly drawn from the well, will frequently roughen the coat of the horse unaccustomed to it, or cause griping pains, or materially lessen the animal's power of exertion. The racing and the hunting groom are perfectly aware of this; and so is the horse, for he will refuse the purest water from the well, if he can obtain access to the running stream, or even the turbid pool. Where there is the power of choice, the soft water should undoubtedly be preferred.

The temperature of the water is of far more consequence than its hardness. It will rarely harm if taken from the pond or the running stream, but its coldness when recently drawn from the well has often been injurious. It has produced colic, spasm, and even death. It should therefore be exposed for some hours, either in the stable or in some tank.

There is often considerable prejudice against the horse being fairly supplied with water. It is supposed to chill him; to injure his wind, or to incapacitate him for hard work. It certainly would do so, if, immediately after drinking his fill, he were galloped hard, but not if he were suffered to quench his thirst more frequently when at rest in the stable. The horse that has free access to water will not drink so much in the course of a day as another who, to cool his parched mouth, swallows as fast as he can, and knows not when to stop.

When on a journey a horse may with perfect safety be far more liberally supplied with water than he generally is. An hour before his work commences he should be permitted to drink a couple of quarts. A greater quantity might be probably objected to. He will perform his task far more pleasantly and effectively than with a parched mouth and tormenting thirst. The prejudice both of the hunting and the training groom on this point is cruel as well as injurious. The task or the journey being accomplished, and the horse having breathed a few minutes, another quart, or even two, will be delightfully refreshing to him, and will never do him harm. His corn may then be offered to him, which he will readily take; and before he has eaten the whole of it two or three more quarts of water may be given.

Towards the close of the day the speed of the traveller should somewhat abate, and the horse should arrive at his resting-place as dry and as cool as circumstances will permit. If he is hot, he must be walked about awhile, or the perspiration will return in the stable. If he is wet, he must be carefully rubbed dry. The sooner this is done the better; and after he is clothed, watered, fed, and bedded, he should as soon as possible be left to his repose. Professor Stewart, of Glasgow, has lately published a very useful work on the 'Stable Economy, or General Management of Horses.' We abridge his account of "the kinds of work, and the preparation for them."

Travelling.—The horse should undergo some degree of training as to the pace, the distance, and the burden. When there has been no preparation, the stages must at first be short, and the pace gentle. For a journey of 300 miles the horse may travel from 20 to 25 miles a day, resting on the Sunday, and doing the work in two stages, at the pace of six miles an hour. This requires a seasoned horse, and the number of working hours per day is about four.

Hunting requires speed and stoutness. The pace seldom exceeds twelve miles an hour, and the run is short, soon over, or interrupted; yet soft sinking ground, hills, and leaps, make this space severe even on the best horses. The time for preparation varies from two to four months. On the day before work the horse should have exercise enough to empty the bowels. If he is a good feeder, he should have no hay within eight hours of starting, nor water within four hours, nor corn within three hours; but if he has five or six miles to go to cover, these restrictions are less necessary. The working days will vary according to his condition and the hardness of the running. He may be able to go out every second day, and sometimes not more than once in six or seven. His spirits and appetite, and the state of his legs, will decide this. Even on the blank days some exercise should be taken in order to evacuate the bowels and create an appetite.

Coaching.—The horses are best prepared for their work by good feeding and gradual increase of speed and distance. The ordinary length of a stage is eight miles; so that a horse is required for every mile, or a coach running between two places forty miles distant employs forty horses to take it away and bring it back. The pace being calculated at from nine to eleven miles an hour, no horse works quite an hour in the day, and some not more than three-quarters of an hour, except that, occasionally, an able horse may perform a double journey in order to relieve a sick companion. No horse therefore leads so easy a life as an English coach-horse in a well regulated establishment. The muscular exertion is severe while it lasts, but it is soon over. The excitement however of high keep and excessive exertion gradually wears the horse down, and it is rarely that he continues in a fast coach more than four years. (Nimrod, *On the Road.*)

Carting. — Cart-horses usually work from eight to ten hours, six days in the week. The pace varies from two miles to three and a half per hour, and the weight rarely exceeds 24 cwt., besides the cart, which probably is seven or eight more. All beyond this in weight or in time of work is cruel.

Ploughing.—The average work is about eight hours in the day. The severity of it depends on the pace, the nature of the soil, and the breadth of the furrow-slice. The pace is from a mile and a half to two miles per hour; the furrow varies from eight inches to eleven, and the distance travelled is from twelve to sixteen miles. The horse and the man can well support this as long as the ploughing season continues.

Diseases of Horses.—It may be readily supposed that the animal doomed to the manner of living just traced in every variety of the horse, will be peculiarly exposed to numerous forms of suffering. Every natural evil will be aggravated, and many new and formidable sources of pain and death will be superadded.

Interest and humanity require that we should become acquainted with the nature and causes and remedy of the diseases of the horse. Only a slight sketch of them can be given here, but sufficient perhaps to enable the owner to recognise their existence, to avoid their causes, or to induce him to apply to the proper quarter for their removal or alleviation.

The principal diseases of the horse are connected with the circulatory system. From the state of habitual excitement in which the animal is kept, in order to enable him to execute his task, the heart and the blood-vessels will often act too impetuously. The vital fluid will be hurried along too rapidly, either through the frame generally or some particular part of it, and there will be *congestion,* accumulation of blood in that part, or there will be *inflammation,* either local or general, disturbing the functions of some organ or of the whole frame.

Congestion.—Take a young horse on his first entrance into the stables; feed him somewhat highly, and what is the consequence? He has swellings of the legs, or inflammation of the joints, or perhaps of the lungs. Take a horse that has lived somewhat above his work, and gallop him to the top of his speed: his nervous system becomes highly excited—the heart beats with fearful rapidity—the blood is pumped into the lungs faster than they can discharge it—the pulmonary vessels become gorged, fatigued, and utterly powerless—the blood arrested in its course, becomes viscid, and death speedily ensues. We have but one chance of saving our patient, viz. the instantaneous and copious abstraction of blood; and one means of preventing the recurrence of this dangerous state, namely, by not suffering too great an accumulation of the sanguineous fluid by over-feeding, and, by regular and systematic exercise, inuring the circulatory vessels to prompt and efficient action when they are suddenly called upon to exert themselves. The cause and the remedy are sufficiently plain.

Again, the brain has functions of the most important nature to discharge, and more blood flows through it than any other portion of the frame of equal bulk. In order to prevent this organ from being oppressed by a too great determination of blood to it, the vessels, although numerous, are small, and pursue a very circuitous and winding course. A horse highly fed, and full of blood, is suddenly and sharply exercised: the course of the blood is accelerated in every direction, and to the brain among other parts. The vessels that ramify on its surface or penetrate its substance are completely distended and gorged with it. Perhaps they are ruptured, and the effused blood presses upon the brain; it presses upon the origins of the nerves on which all sensation and motion depend, and the animal suddenly drops powerless. A prompt and copious abstraction of blood, or in other words a diminution of this pressure, can alone save the patient. Here is the nature, the cause, and the treatment of *apoplexy*.

Sometimes this disease assumes a different form. The horse has not been performing more than his ordinary work, or perhaps he may not have been out of the stable. He is found with his head drooping and his vision impaired. He is staggering about; he falls, and lies half unconscious, or he struggles violently and dangerously. There is the same congestion of blood in the head, the same pressure on the nervous origins, but produced by a different cause. He has been accustomed habitually to overload his stomach, or he was on the previous day kept too long from his food, and then he fell ravenously upon it, and ate until his stomach was completely distended and unable to propel forward its accumulated contents. Thus distended, its blood-vessels are compressed, and the circulation through them is impeded or altogether suspended. The blood is still forced on by the heart, and driven in accumulated quantity to other organs, and to the brain among the rest; and there congestion takes place, as just described, and the animal becomes sleepy, unconscious, and, if he is not speedily relieved, he dies. This too is apoplexy; the horseman calls it *stomach staggers*. Its cause is improper feeding. The division of the hours of labour, and the introduction of the *nose-bag*, have much diminished the frequency of its occurrence. The remedies are plain,—bleeding, physicking, and the removal of the contents of the stomach by means of a pump contrived for that purpose.

Congestions of other kinds occasionally present themselves. It is no uncommon thing for the blood to loiter in the complicated vessels of the *liver*, until the covering of that viscus has burst, and an accumulation of congealed black blood has presented itself. It is the same with the *spleen*. It constitutes the *swelled legs* to which so many horses are subject when they stand too long idle in the stable. Congestion is the source of many of the accumulations of serous fluid in various parts of the body, and particularly in the chest, the abdomen, and the brain.

Inflammation is opposed to *congestion*, as consisting in an active state of the capillary arterial vessels; the blood rushing through them with far greater rapidity than in health, from the excited state of the nervous system, by which they are supplied.

Inflammation is either *local* or *diffused*. It is confined to one organ, or to a particular portion of that organ; or it involves many neighbouring ones, or it is spread over the whole frame. In the latter case it assumes the name of *fever*. Fever is general or constitutional inflammation, and is said to be *sympathetic* or *symptomatic* when it can be traced to some local affection or cause, and *idiopathic* when we cannot so trace it. The truth probably is that every fever has its local cause, but we have not a sufficient knowledge of the animal economy to be able to discover it.

Inflammation may be considered with reference to the membranes which it attacks.

The *mucous membranes* line all the cavities that communicate with the external surface of the body. There is frequent inflammation of the membrane of the mouth. *Blain*, or *Glossanthrax*, is a vesicular enlargement which runs along the side of the tongue. Its cause is unknown. It should be lanced freely and deeply, and a little aperient medicine administered. *Barbs*, or *paps*, are smaller enlargements, found more in the neighbourhood of the bridle of the tongue. They should never be touched with any instrument: a little cooling medicine will generally remove them. *Lampas* is inflammation of the palate, or enlargement of the bars of the palate. The roof of the mouth may be slightly lanced, or a little aperient medicine administered;

but the sensibility of the mouth should never be destroyed by the application of the heated iron. *Canker* and *wounds in the mouth*, from various causes, will be best remedied by diluted tincture of myrrh, or a weak solution of alum. *Foreign bodies in the gullet* may generally be removed by means of the probang used in the hoove of cattle; or the œsophagus may be opened, and the obstructing body taken out. It is on the mucous membranes that *poisons* principally exert their influence. The *yew* is the most frequent vegetable poison. The horse may be saved by timely recourse to equal parts of vinegar and water injected into the stomach, after the poison has been as much as possible removed by means of the stomach-pump. For arsenic or corrosive sublimate there is rarely any antidote. *Spasmodic colic* is too frequently produced by exposure to cold, or the drinking of cold water, or the use of too much green meat. The horse should be walked about; strong friction used over the belly, and spirit of turpentine given in doses of two ounces, with an ounce each of laudanum and spirit of nitrous æther, in warm water or ale. If the spasm is not soon relieved the animal should be bled, an aloetic ball administered, and injections of warm water with a solution of aloes thrown up. This spasmodic action of the bowels, when long continued, is liable to produce *intro-susception*, or *entanglement*, of them, and the case is then hopeless. *Superpurgation* often follows the administration of a too strong or improper dose of physic. The torture which it produces will be evident by the agonised expression of the countenance, and the frequent looking at the flanks. Plenty of thin starch or arrow-root should be given both by the mouth and by injection; and, twelve hours having passed without relief being experienced, chalk, catechu, and opium should be added to the gruel. *Worms* in the intestines are not often productive of much mischief, except they exist in very great quantities. Small doses (two drachms) of emetic tartar with a little ginger may be given to the horse half an hour before his first meal, in order to expel the round white worm; and injections of linseed-oil or aloes will remove the ascarides, or needle-worms.

The *respiratory passages* are all lined by the mucous membrane. *Catarrh*, or *cold*, inflammation of the upper air passages, should never be long neglected. A few mashes or a little medicine will usually remove it. If it is neglected, and, occasionally, in defiance of all treatment, it will degenerate into other diseases. The larynx may become the principal seat of inflammation. *Laryngitis* will be shown by extreme difficulty of breathing, accompanied by a strange roaring noise, and an evident enlargement and great tenderness of the larynx when felt externally. The windpipe must be opened in such case, and the best advice will be necessary. Sometimes the subdivisions of the trachea, before or when it first enters the lungs, will be the part affected, and we have *bronchitis*. This is characterized by a quick and hard breathing, and a peculiar wheezing sound, with the coughing up of mucus. Here too decisive measures must be adopted, and a skilful practitioner employed. So should he in *distemper*, *influenza*, and *epidemic catarrh*, names indicating the same disease, and produced by atmospheric influence, varying to a certain degree in every season, but in all characterized by intense inflammation of the mucous surfaces, and by rapid and utter prostration of strength, and in all demanding the abatement of that inflammation, and yet no expenditure of vital power.

Cough may degenerate into *inflammation of the lungs*; or this fearful malady may be developed without a single premonitory symptom, and may prove fatal in twenty-four or even in twelve hours. It is mostly characterized by deathy coldness of the extremities, expansion of the nostril, redness of its lining membrane, singularly anxious countenance, constant gazing at the flank, and an unwillingness to move. A successful treatment of such a case can be founded only on the most prompt and fearless and decisive measures. The lancet must be freely used; counter-irritants must follow as soon as the violence of the disease is in the slightest degree abated; sedatives must succeed to them, and fortunate will he be who often saves his patient after all the decisive symptoms of pneumonia are once developed.

Among the consequences of these severe affections of the lungs are *chronic cough*, not always much interfering with the usefulness of the horse, but strangely aggravated at times by any fresh accession of catarrh, and too often degenerating into *thick wind*, which always materially interferes with the speed of the horse, and in a great proportion of cases terminates in broken wind. It is rare indeed that either of these diseases admits of cure, nor does that obstruction in some part of the respiratory canal, and varying in almost every horse, which produces the peculiar sound termed *roaring*.

Glanders, the most destructive of all the diseases to which the horse is exposed, is the consequence of breathing the atmosphere of foul and vitiated stables—the winding up of almost every other disease, and in every stage of it most contagious. Its most prominent symptoms are a small but constant discharge of sticky matter from the nose, an enlargement and induration of the glands beneath and within the lower jaw, on one or both sides; and, before the termination of the disease, chancrous inflammation of the nostril on the same side with the enlarged gland. Its contagiousness should never be forgotten, for if a glandered horse is once introduced into a stable, almost every horse in it will sooner or later become infected and die.

The urinary and genital organs are also lined by mucous membranes. The horse is subject to *inflammation of the kidneys* from eating musty oats or mowburnt hay, from exposure to cold, and from injuries of the loins. Bleeding, physic, and counter-irritants over the region of the loins should be had recourse to. *Diabetes*, or *profuse staling*, is difficult to treat. The inflammation that may exist should first be subdued; and then opium, catechu, and the uva ursi administered. *Inflammation of the bladder* will be best alleviated by mucilaginous drinks of almost any kind. *Inflammation of the neck of the bladder*, evinced by the frequent and painful discharge of small quantities of urine, will yield only to the abstraction of blood and the exhibition of opium. A catheter may be easily passed into the bladder of the mare, and the urine evacuated, but it will require a skilful veterinary surgeon to effect this in the horse. A *stone in the bladder* is readily detected by the practitioner, and may be extracted with comparative ease. The sheath of the penis often becomes diseased from the presence of corrosive mucous matter; it may easily be removed with warm water and soap.

To the mucous membranes belong the conjunctival tunic of the eye, and the diseases of the eye generally may be here considered. A *scabby itchiness* on the edge of the eye-lid may be got rid of by a diluted nitrated ointment of mercury. *Warts* should be cut of with the scissors, and the roots touched with lunar caustic. *Inflammation of the haw* should be abated by the employment of cooling lotions, but that useful defence of the eye should never, if possible, be removed. Common *ophthalmia* will yield as readily to cooling applications as inflammation of the same organ in any other animal; but there is another kind of inflammation, commencing in the same way as the first, and for a while apparently yielding to treatment, but which changes from eye to eye, and returns again and again, until blindness is produced in one or both organs of vision. The most frequent cause is hereditary predisposition. The reader cannot be too often reminded that the qualities of the sire, good or bad, descend, and scarcely changed, to his offspring. How *moon-blindness* was first produced no one knows; but its continuance in our stables is to be traced to this cause principally, or almost alone, and it pursues its course until cataract is produced, for which there is no remedy. *Gutta serena* (palsy of the optic nerve) is sometimes observed, and many have been deceived, for the eye retains its perfect transparency. Here also medical treatment is of no avail.

The serous membranes are of great importance. The brain and spinal marrow, with the origins of the nerves, are surrounded by them; so are the heart, the lungs, the intestinal canal, and the organs whose office it is to prepare the generative fluid.

Inflammation of the Brain.—Mad staggers falls under this division. It is inflammation of the meninges, or envelopes of the brain, produced by over-exertion, or by any of the causes of general fever, and it is characterised by the wildest delirium. Nothing but the most profuse blood-letting, active purgation, and blistering the head will afford the slightest hope of success. *Tetanus*, or *Locked Jaw*, is a constant spasm of all the voluntary muscles, and particularly those of the neck, the spine, and the head, arising from the injury of some nervous fibril—that injury spreading to the origin of the nerve—the brain becoming affected, and universal and unbroken spasmodic action being the result. Bleeding, physicking, blistering the course of the spine, and the administration of opium in enormous doses, will alone give any chance of cure. *Epilepsy* is not a frequent disease in the horse, but it seldom admits of cure. It is also very apt to return at the most distant and uncertain intervals. *Palsy* is the suspension of nervous power. It is usually confined to the hinder limbs, and sometimes to one limb only. Here bleeding and physicking, and antimonial medicines, and blistering of the spine, are the most rational applications, but they too often utterly fail of success. *Rabies*, or madness, is evidently a disease of the nervous system, and once being developed is altogether without cure. The utter destruction of the bitten part with the lunar caustic, soon after the infliction of the wound, will however, in a great majority of cases, prevent the development of the disease.

Pleurisy, or inflammation of the serous covering of the lungs and the lining of the cavity of the chest, is generally connected with inflammation of the substance of the lungs; but it occasionally exists independent of any state of the lungs. The pulse is in this case hard and full, instead of being oppressed; the extremities are not so intensely cold as in pneumonia, [illegible] membrane of the nose is little redd[illegible] and the sides are tender. It may be of importance to distinguish between the two, because in pleurisy more active purgation may be pursued, and the effect of counter-irritants will be greater, from their proximity to the seat of disease. Copious bleedings and sedatives here also should be had recourse to. It is in connexion with pleurisy that a serous fluid is effused in the chest, the existence and the extent of which may be ascertained by the practised ear, and which in many cases may be safely evacuated.

The heart is surrounded by a serous membrane, the pericardium, that secretes a fluid, the interposition of which prevents any injurious friction or concussion in the constant action of this organ. If this friction increases to too great a degree the action of the heart may be impeded or destroyed—this is *dropsy of the heart:* it is difficult to detect, and more difficult to cure. The heart itself is often diseased; it sympathises with the inflammatory affection of every organ, and therefore is itself occasionally inflamed. *Carditis*, or *inflammation of the heart*, is characterised by the strength of its pulsations, the tremour of which can be seen, while the sound can be heard at a distance of several yards. Speedy and copious blood-letting will afford the only hope of cure in such a case.

The outer coat of the stomach and intestines is composed of a serous membrane, the peritoneum, which adds strength and firmness to their textures; attaches and supports and confines them in their respective places, and secretes a fluid that prevents all injurious friction between them. This coat is exceedingly subject to inflammation, somewhat gradual in its approach; the pulse quickened, but small; the legs cold; the belly tender; there being constant pain, and every motion increasing it; there also being rapid and great prostration of strength. These symptoms will sufficiently characterise *peritoneal inflammation.* Bleeding, aperient injections, and extensive counter-irritation, will afford the only hope of cure.

The time for *castration* varies according to the breed and destiny of the horse. On the farmer's colt it may be effected when the animal is not more than four or five months old, and it is comparatively seldom that a fatal case then occurs. For other horses much depends on their growth, and particularly on the development of their fore quarters. Little improvement has been effected in the old mode of castrating, except the opening of the scrotum, and the division of the cord by the knife, instead of the heated iron.

Synovial or *joint membranes* are interposed between the divisions of the bones, and frequently between the tendons, in order to secrete a certain fluid that shall facilitate motion and obviate friction. Occasionally the membrane is lacerated, and the synovia escapes. This is termed *opened joint*, and violent inflammation rapidly ensues. The duty of the practitioner is to close this opening, and as quickly as possible. Nothing is so effectual here as the old application of the cautery. A great deal of inflammation and engorgement is produced around the opening, partially, if not altogether, closing it; or at least enabling the coagulated synovia to occupy and obliterate it. Perhaps in order to insure the desired result, the whole of the joint should be blistered; a bandage should then be firmly applied, and kept on as long as possible. If after this there is any eruption of the synovia, the cautery must again be had recourse to.

The Navicular Disease is a bruise, or inflammation, or perhaps destruction, of the cartilage of the navicular bone, where the flex or tendon of the foot passes over it in order to reach the coffin-bone. The veterinary surgeon can alone ascertain the existence and proper treatment of this disease. *Spavin* is an enlargement of the inner side of the hock. The splent bones which support the inferior layer of those of the hock sustaining a very unequal degree of concussion and weight, the cartilaginous substance which unites them to the shank bone takes on inflammation, it becomes bony instead of cartilaginous, and the disposition to this change being set up in the part, bony matter continues to be deposited, until a very considerable enlargement takes place, known by the name of *spavin*, and there is considerable lameness in the hock joint. The bony tumour is blistered, and probably fired, but there is no diminution of the lameness until the parts have adapted themselves, after a considerable process of time, to the altered duty required of them, and then the lameness materially diminishes, and the horse becomes to a very considerable extent useful. *Curb* is an enlargement of the back of the hock, three or four inches below its point. It is a strain of the ligament which there binds the tendons down in their place. The patient should be subjected to almost absolute rest; a blister should be applied over the back of the tumour, and, occasionally, firing will be requisite to complete the cure. Near the fetlock, and where the tendons are exposed to injury from pressure or friction, little bags or sacs are placed, from which a lubricating mucous fluid constantly escapes. In the violent tasks which the horse occasionally has to perform, these become bruised and inflamed, and enlarged and hardened, and are termed *windgalls;* they blemish the horse, but are no cause of lameness after the inflammation has subsided, unless they become very much enlarged. The cautery will then be the best cure. Immediately above the hock enlargements of a similar nature are sometimes found, and, as they project both inwardly and outwardly, they are termed *thorough pins.* They are seldom a cause of lameness, but they indicate great and perhaps injurious exertion of the joint. On the inside of the hock a tumour of this kind, but of a more serious nature, is found. It is one of these enlarged mucous bags, but very deeply seated, the subcutaneous vein of the hock passing over it. The course of the blood through the vein is thus in some measure arrested, and a portion of the vessel becomes distended. This is a serious evil; for, from the deep-seatedness of the mucous bag, it is almost impossible to act effectually upon it. It is termed *bog* or *blood spavin.*

The cellular tissue which fills the interstices of the various organs, or enters into their texture, is the seat of many diseases. From the badness of the harness, or the brutality of the attendant, the poll of the horse becomes contused. Inflammation is set up, considerable swelling ensues, and an ulcerative process soon commences, and chasms and sinuses of the most frightful extent begin to appear. The withers are probably bruised, and the same process takes place there, and sinuses penetrate deep beneath the shoulder, and the bones of the withers are frequently exposed. These abscesses are termed *poll evil* and *fistulous withers*, and in the treatment of them the horse is often tortured to a dreadful and disgraceful extent. A better mode of management has however been introduced: setons are passed through the most dependent parts; no collection of sanious fluid is permitted to exist, and milder stimulants are applied to the surface of the ulcer.

An abscess of a peculiar character is found between the branches of the lower jaw in young horses; it is preceded by some degree of fever. It is usually slow in its progress, but at length it attains a considerable size, including the whole of the cellular tissue in that neighbourhood. There is one uniform mass of tumefaction. This is *strangles.* It seems to be an effort of nature to get rid of something which oppresses the constitution, and the treatment of it is now simple and effectual. It is encouraged by fomentations and by blisters: it is punctured as soon as the fluctuation of a fluid within it can be fairly detected, the pus speedily escapes, and there is an end of the matter.

To one disease of the absorbent system a brief reference must be made.

Farcy.—While the arterial capillaries are engaged in building up the frame, the absorbents are employed in removing that which not only is useless, but which would be poisonous and destructive. They take up the matter of glanders and of every ulcerating surface, and they are occasionally irritated, inflamed, and ulcerated, from the acrimonious nature of the poison which they carry. The absorbents are furnished with numerous valves; the fluid is for a while arrested by them, and there the inflammation is greatest, and ulceration takes place. This is the history of the farcy cords and buds. Farcy is a highly contagious disease, whether or not it be connected with glanders. It, however, occasionally admits of cure from the application of the cautery to the bud, and the administration of the corrosive sublimate or the sulphate of iron internally.

The skin of the horse is subject to various diseases. Large pimples or lumps suddenly appear on the skin, and, after remaining a few days, the cuticle peels off, and a circular scaly spot is left: this is called *surfeit.* The cause is obscure, but principally referable to indigestion. A slight bleeding will always be serviceable; physic rarely does good, but alteratives composed of nitre, black antimony, and sulphur will be very beneficial. *Mange* is a disease of a different character. It is the curse of the stable into which it enters, for it will almost certainly affect every horse. Thorough dressings with Barbadoes tar and linseed oil, in the proportion of one of the former to three of the latter, will be the most effectual external application, while alteratives and physic should be given internally. *Hide-bound* is a very appropriate term for the peculiar sticking of the hide to the ribs when a horse is out of condition. The subcutaneous adipose matter is all absorbed. The alterative above recommended will be very useful here. *Grease* is an undue secretion of the fluid which was designed to lubricate the skin of the heels, and that secretion being also altered in quality. The hind legs begin to swell, a fluid exudes from the heels, the hairs of the heels become erect like so many bristles, and the skin of the heel is hot and greasy. Soon afterwards cracks appear across the heel: they discharge a thick and offensive matter, and then deepen. They spread up the leg, and so does the tumefaction of the part. In process of time the skin, inflamed and ulcerated, undergoes an alteration of structure; prominences or granulations appear on it, assuming the appearance of a collection of grapes, or the skin of a pine-apple. They increase, and a fœtid discharge appears from the crevices between them.

The cause is generally neglect of the horse. He is suffered to stand in the stable with his heels cold and wet, and this must necessarily dispose them to inflammation and disease.

In the first stage of grease, bran or turnip or carrot poultices will be serviceable, with moderate physic. Then astringents must be employed, and the best are alum or sulphate of copper in powder, mixed with eight times the quantity of Bole Armenian, and sprinkled on the sores. These should be alternated every three or four days. The grapy heels are a disgrace to the stable in which they are found, and admit not of radical cure.

As to the structure, shoeing, and diseases of that admirable organ the foot of the horse, the reader is referred to Goodwin 'On Shoeing,' Blaine's 'Veterinary Outlines,' and the treatise on 'The Horse,' published by the Society for the Diffusion of Useful Knowledge.

HUNTINGDONSHIRE AGRICULTURE.—The climate of Huntingdonshire partakes of that of the inland counties. The low and flat districts, which are mostly drained fens, are subject to fogs, and not so healthy as the higher parts; but when well drained and cultivated, they become more healthy. The county contains a surface of nearly 195,000 acres, of which a very small portion only remains unproductive.

The soil varies considerably, and may be said to lie in patches of gravel, sand, and clay, intermixed with muddy alluvial vegetable earth, wherever the level of the surface is lowest, and the waters have formerly flowed over it, or stagnated upon it. Peat is found in many spots, and dug out for fuel. The clay predominates generally.

Although water abounds, there are not many springs, but the inhabitants are supplied from ponds, rivers, and wells. The well-water is not of the best quality: in this respect the county resembles the lower parts of Holland. The farms are mostly of considerable extent, and the farm-buildings are generally situated at an inconvenient distance from the most productive fields. This is owing to the nature of the soil: a drier spot, rather higher than the level of the fens, is chosen for the buildings. Leases are not so common in this county as they might be, with great advantage to both landlord and tenant; and rents are not high in proportion to the produce. The expense of cultivation on the fen-land, when it is first drained, bears no proportion to the produce. Paring and burning the surface is the general practice. The ashes being spread and thinly ploughed in, rape-seed is sown, which is fed off with sheep the first year, and left to ripen its seeds the next. The stem or straw of the rape is burned on the land, after the seed has been thrashed out; and this is all the manure required to produce a good crop of wheat, if the land is sufficiently mellow. Where it is wet and heavy, oats are substituted for the wheat, and are more profitable, from the greater certainty of the crop on such lands. The next crop is beans, which are sown or drilled after a good dressing with dung, and with a deeper ploughing. The next crop is barley with grass seeds, which are mown or pastured from three to five years. The land is then pared and burned again, and the same rotation is repeated. There is no fault to find with this system, if it be accompanied with sufficient tillage. A fallow may be advantageously introduced; and without it the land will scarcely be kept sufficiently free from weeds, especially the coarse natural grasses, of which the roots remain in the soil, when it is not summer fallowed. The following rotation is more extensive, and, on good land, very profitable:—1, rape, after paring and burning; 2, wheat; 3, beans; 4, barley; 5, clover; 6, wheat; 7, fallow; 8, wheat; 9, beans; 10, barley; and grass seeds to lie three or four years. After fifteen years the paring and burning may be repeated with advantage: oats are not included; but they may be sown on a portion of the wheat land after clover. Where land is rich, oats are not a profitable crop, and should be sown on the poorer lands. There is always a portion of a farm where oats may be more profitable than wheat, and there the rotations may be different. On the lighter soils, where turnips will grow, paring and burning are not so advantageous, except in first converting waste lands, or old pastures overrun with coarse grass and rushes, into arable land. On such lands the usual course is:—1, turnips off with sheep; 2, oats; 3, beans; 4, barley; 5, clover; 6, wheat. The course then begins again, or seeds are sown amongst the wheat in spring, to lie several years, which greatly invigorates the soils, and, with good management, is the most profitable system.

The average produce of the county,

according to the Agricultural Survey published in 1813, does not denote great fertility in the soil, or good tillage and management. Of ninety-four parishes of which returns are given, there are only seven which produce 25 bushels of wheat per acre, and only two which produce 30 bushels; while there are twenty-three of which the average is under 20 bushels. There are sixteen which produce 40 bushels of barley, and thirty-five which average under 30 bushels; twenty-one produce 40 bushels of oats per acre, and thirty-two under 30 bushels. There has, no doubt, been a considerable increase of the average produce by a better system of cultivation; but in many farms there is very little improvement. The reason of this low average must be ascribed to a long system of over-cropping, which all the fen-lands have been subjected to when first drained. The fertility was thought inexhaustible, because great crops were obtained at first with little trouble; but the vegetable portion of the soil was soon exhausted, and no subsequent manuring could adequately replace it. Folding sheep on the fallows is a very general practice; but, except on light soils, which are benefited by the treading of the sheep and by their urine, without injuring the health of the animal, folding on fallows is a most expensive mode of manuring, more being lost by the harm done to the sheep than can be gained by the increase of the crop. On dry grass-land the case is different: there the sheep will not suffer, and the grass is much benefited. Mustard-seed is grown to some extent in this county, and in good soils gives a good return. It is thought to exhaust the land, but it does not do so more than rape. It requires to be well manured, and not repeated too often. The price of mustard-seed varies much, and there is not always a demand for it; but it may be stacked, and will keep well for a long time.

On the borders of the Ouse and Nene are some very rich meadows, but there is not a sufficient supply of running water to form artificial water-meadows. The grass is coarse naturally, but by close feeding with sheep in summer its quality is much improved.

A great part of the county is still in pasture, although much has been broken up and converted into arable land. In 1813, according to the survey, the meadows and pastures were nearly equal in extent to half the arable land. It is calculated that the best pastures will produce 420 lbs. of meat per acre, which, at 4*d.* per lb., would give five guineas per acre. It is not surprising, then, that they should not be ploughed up. The pastures are not sufficiently subdivided: a greater number of ditches would keep them much drier and more productive. A contrivance is noticed in some of the pastures to enable the sheep to rub their backs: it consists of two short posts put in the ground at ten feet apart, and a strong rail fastened to them a little lower than the height of a sheep, so that by going under it they can rub their backs. This contrivance prevents their rolling, and consequently being cast, as often happens to fat sheep. Another method has been found out, which is to dip them in a liquor which kills the ticks: the desire of rubbing is thus prevented, and the wool is not damaged.

The county of Huntingdon is rather bare of trees. There are a few woods and coppices, but not many trees in the hedge-rows. In the marshy parts willows grow rapidly, and are profitable, although not ornamental.

Horses are invariably used for the plough; but, with a few exceptions, the number of horses kept on a farm is greater than is necessary. The custom of using four strong horses, one before the other, in the plough, is not yet generally abandoned, even in comparatively light soils. In some improved farms in the fens they use three horses abreast in a plough, without any driver, than which nothing can be better where the soil is really too heavy to be ploughed to a sufficient depth with two horses.

The cows kept for the dairy are mostly of the Yorkshire or Durham breed of short-horns. The cows bred in the county are not good: too little attention is paid to keep any breed select and pure.

Although Stilton is in this county, and it is asserted that the cheese which bears that name was originally made there, none of that kind is now produced in any of the dairies: all such cheeses are made in Leicester or Lincolnshire.

The sheep are mostly of the Leicester breed. The hogs are of the Berkshire or Leicestershire breeds, with various crosses.

HUSBANDRY.—The origin of the simplest arts of life is involved in the obscurity which envelops the early history of the human race. Before there can be any motives to record events, some considerable progress must have been made in civilization. When attention is altogether directed to obtaining the means of subsistence, there is little leisure, nor is there any great desire, to communicate the knowledge acquired by experience. Warlike achievements are the first things recorded; and the peaceful labours of the husbandman are overlooked. In the fables which in the early ages of the world supplied the place of authentic histories, some conspicuous character was always made the inventor of the various arts of which the origin was unknown; and to such personage a divine origin was frequently ascribed. Thus Cadmus is said to have invented letters, and Triptolemus to have made the first plough.

In the oldest writings which have been handed down to us, the common operations of husbandry are mentioned, or alluded to, in nearly the same terms in which we should describe them now—the same implements were then in use, and the same productions raised which are now found in the same climates; but they are only mentioned incidentally. It requires a very advanced state of the arts and of literature to produce a treatise on any one practical subject exclusively; and the simpler and more common the arts, the less they are noticed in the early literature of a nation. We have, however, no other means of tracing the progress of husbandry than by the works of those who have written on the subject, until we come to our own times, when everything is noted and commented on, and every one who makes any discovery or improvement is anxious that the public should be acquainted with it. We have already mentioned some of the early Greek authors [ARABLE-LAND], and likewise some of the Latin authors who are most generally known as having treated of husbandry in general. (*De Re Rustica.*) From these authors we learn that considerable progress had been made in the tillage of the ground and in the breeding and rearing of the domestic animals: and it appears that wherever the Romans carried their victorious arms, they also introduced improved methods of cultivation. The practice of fallowing land, to restore its fertility, can be clearly traced to them. For a long time the Latin authors were the source from which all writers on husbandry derived their knowledge; and hence many useless and absurd rules which were connected with the pagan superstition were perpetuated.

The Mediterranean Sea and the countries situated around it were once the centre of all the arts, which had slowly travelled westward from Asia and from Egypt; and the colonies which the Greeks and Romans planted on all the coasts of this sea, and in the countries which they conquered, contributed to diffuse a knowledge of the various products of the earth. The irruption of the barbarians into the Roman empire greatly checked the progress of husbandry; but the destruction of the Eastern empire, while it made the Greeks retrograde in civilization, tended to introduce improvements into those countries where men of learning and science sought a refuge from the invaders.

British Husbandry.—The husbandry of the aboriginal Britons was probably very imperfect before the invasion of Julius Cæsar; but we have no records to inform us. Rural matters were of too little importance in the eyes of conquerors to engage much of their attention, but the mildness of the climate and the general fertility of the country induced many of the Romans to settle here; and from them the natives learned a better system of cultivation than that of their ancestors.

As far as we can learn from ancient documents, the land in England formerly consisted chiefly of woods and of extensive pastures, in which sheep and cattle were bred, which constituted the chief wealth. A very small proportion of the soil was cultivated: and, while the population was thin, there was no difficulty in obtaining land which had never before been broken up, and which with little trouble or manuring produced moderate crops of corn. But this system could not last long. The proprietors of land would soon perceive that the produce fell off, and would consequently restrict the breaking up of pastures, and thus more attention was necessarily paid to the arable lands in cultivation.

Through the deficiency of the laws, or the difficulty of executing them, and the frequent intestinal wars between the barons, depredations were often committed with impunity; and the cultivators of the soil congregated in villages for mutual protection and defence. The best land nearest to the habitations was cultivated, and the common pastures fed the cattle without much trouble or expense. The consequence of this system was, that very little manure was made, and the cultivated fields scarcely produced a return adequate to the expense of cultivation. Four times the seed was a full average for corn crops, and the land was overrun with weeds after a single crop. Hence it was not an uncommon practice to have a fallow every other year, and this was considered a superior system to having two crops between the fallows, which has been more common since. Wheat was very little cultivated; barley, rye, and oats were the principal produce.

The woods nourished many hogs on the acorns and beech-mast which abounded there, and the right of turning hogs into the king's forests was granted under the barbarous terms of *mastagium* and *rootagium*.

The religious orders, to whom extensive grants of waste lands were made, greatly contributed to the improvement of agriculture. The monks, by their knowledge of Latin, were enabled to study the Roman authors on husbandry, and, by applying the rules and principles which they drew from that source, they greatly improved their estates, and made the land more productive: teaching and encouraging their tenants to till the land more effectually, they were, upon the whole, better and more indulgent landlords than the nobles, who, provided they secured retainers and supplied their households with necessaries, gave themselves little trouble about anything else. Bread made of rye, barley, peas, or beans, was the principal food of the labourers, who were attached to the soil, and had no right to remove to another place, or serve any other master. The immediate tenants of the lord of the soil cultivated a portion of the lands which they held for their own use, and let the remainder to smaller tenants, who, although born free, were little above the condition of the labourers, and lived much in the same manner. There was so little capital among the farmers, that the live stock was frequently the property of the landlord, and was let with the land, as well as the servants. As to implements, they were very few in number, and rudely made by the farmer himself; an iron plough-share, an axe, and a spade were the principal instruments for which he had to pay.

Oxen, which could be kept on the common pastures at little expense, were used for the plough; and so badly fed were they in general, that it required six oxen to draw a plough, which barely turned up half an acre in a summer's day. These oxen consumed all the straw of the farm in winter, and little was left to make manure of. Horses carried the corn to the mill or market on their backs, the roads being mostly impassable for wheel-carriages, which indeed were unknown in many parts of the country.

These particulars can only be gleaned out of various authors, who incidentally mention the state of the agricultural population, and from antient deeds and documents.

With the revival of letters, and especially with the invention of the art of printing, greater attention began to be paid to rural affairs; but all the early English or foreign authors who touch on the subject of agriculture took their notions from the authors *De Re Rustica*, and rather say what should be done, than what really was done.

The first English author of any note who wrote on husbandry was Sir Antony Fitzherbert, who has by many been looked upon as the father of English husbandry. He published his 'Book of

Husbandrie' in 1523. This work throws considerable light on the state of the farmers in those days, who, with their wives and children, worked hard, and were little raised above the common labourers, except that they were freemen. A yeoman who had land of his own was a very independent man; but his mode of living was extremely plain, and he had no luxuries. Money was seldom seen in his possession. He lived on the produce of his land, and fed his labourers at his own board. Wool was the principal article sold. The sheep were kept on extensive commons at little expense; and in some places the folding of them on the land was the principal mode of recruiting it when exhausted. The great difficulty was to keep them alive in severe winters, and many perished every year. The only provender they had was hay; and as artificial grasses and turnips were unknown, natural meadows paid an enormous rent, when compared with arable land. For want of winter provender for cattle, many were killed which were not sufficiently fat. Very little fresh meat was eaten after Christmas, and every family had oxen and sheep killed and salted in autumn to last till the next summer.

In the time of Elizabeth some attention began to be paid to the improvement of husbandry, but no works of any note have come down to us in which we can discover that any considerable change was made in the common modes of tillage or in the rearing and feeding of cattle.

The situation of the farmers, however, appears to have improved; they began to acquire wealth and to increase their domestic comforts. The farm-houses were more solidly built and commodious, having before been chiefly constructed of wood, and the walls plastered with clay.

Cromwell encouraged husbandry, and gave a pension to Hartlib, who published in 1641 a work on the husbandry of Flanders, and another in 1651, called the 'Legacy of Husbandry.' Walter Bligh, the friend and contemporary of Hartlib, published in 1652 another work called 'The Improver Improved.' This work is deserving of notice. It contains very sound principles of husbandry, with many excellent observations, which may be of great use even in our days. The author mentions clover as an important object of cultivation introduced from the Netherlands; and he may be considered as the first who recommended sowing this plant for feeding cattle. Sir Richard Weston, who soon after gave an account of the cultivation of turnips in Flanders, laid the foundation of the improved system of husbandry, of which the feeding of cattle and sheep on turnips in winter is the chief feature.

From that time to the present day husbandry has improved slowly but regularly. With the increase of population, and a consequent increased demand for the produce of the soil, there has arisen a new species of speculation—that of reclaiming waste lands, by which the estates of many landed proprietors have been greatly improved. But the most important step has been the granting of long leases to those who were inclined to lay out their capital and employ their skill in improving farms. The security which the law gives to a leaseholder, and his independence of his landlord, provided the rent be duly paid, is the greatest encouragement to industry; and it will be invariably found that the improvement of any district is proportioned to the length of time for which leases are granted there, at a fair annual rent, without uncertain fines.

The spirit of improvement and the hope of increasing his income often lead a man to mistaken experiments and consequent loss; but the experience thus gained is always valuable to the community. Jethro Tull, a gentleman who had a property near Hungerford in Berkshire, introduced a mode of cultivation which was prevalent in Lombardy, and was borrowed from the practice of gardeners, who sow and plant their vegetables in rows with wide intervals. Finding that in rich soils the produce was much increased by stirring the earth round the roots of plants, he formed a theory respecting the food of plants, which he imagined to be extremely finely attenuated earth. He thought that manures acted only mechanically, and that by continually stirring the soil it might be kept perpetually fertile. The attractive part of this theory was, that whereas the supply of manure is limited, there is no limit to labour, and that consequently an increase of population only required an increase of tillage to supply it with food. Tull was admired, and his theory adopted by many eminent men. His practical system, to which the name of *drill-husbandry* has been given, was looked upon as one of the most important discoveries. But it was soon found that his imagination had led him too far, and he injured his fortune greatly by his experiments and his practice. Notwithstanding this, he must be considered as one of the great promoters of good husbandry. Even his errors have been useful by making men observe and reflect; and the introduction of machines to drill the seed in rows, and of others to clean and hoe the intervals, which he principally suggested, has been of infinite use to the improved cultivation of the soil.

The rearing and fattening of cattle on the produce of arable land, which followed the introduction of sainfoin, lucern, and other artificial grasses, and the cultivation of roots for the same purpose, have made a great change in the old systems. Manure is produced in greater quantity; the land is increased in productive power, and will bear more frequent crops of corn; better implements have been invented to save labour and do the work more completely; and a system of draining has been introduced, which has corrected the great fault of most strong soils in northern climates—excessive moisture which cannot evaporate. Many causes have concurred to produce these improvements. At one time high prices induced men to lay out their capital on the cultivation of the soil; at another, low prices stimulated industry to make up by an increased production for a deficiency in the value; and what has contributed greatly to keep attention directed towards agricultural improvements is the rapid increase of the means of communicating information by the press. Every successful experiment, every new method which the inventor thinks of importance, is speedily announced to the public.

The improvements which have been made in the breeds of cattle and sheep may be considered as entirely modern. The profit which some eminent breeders have made, and, to some extent, still make, by their attention and their skill, is a sufficient inducement to excite competition. Mr. Collins and Mr. Bakewell may be cited as examples of successful attention to breeding. Mr. Collins obtained at a public sale of his cattle—

For 17 cows of all ages . .	£2669
For 11 bulls	2249
For 7 bull-calves under 1 year old	655
For 7 heifers . . .	808
For 5 heifer-calves under 1 year	306
Making for 47 head of cattle of all ages . . .	£6687

At another sale of Mr. Fowler's stock in 1791, fifty head of cattle brought 4289*l.* 4*s.* 6*d.*

Such prices are a great inducement to pay attention to breeding.

To enumerate the various works which have come from the press on subjects connected with husbandry would be to give a catalogue of a large library. We can only mention some of the principal authors, such as Lord Kames, Marshall, Arthur Young, Sir John Sinclair, and Dickson. Of these the most original author is the first. His 'Gentleman Farmer' contains much excellent information and useful practice. The others, although confessedly compilers, have great merit in the manner in which they have brought forward the various information which they have collected. The 'Farmer's Magazine,' which appeared in 1800, and continues under a new set of editors to this day, has done much good in disseminating useful practices in husbandry. British husbandry owes much to the zeal and activity of individuals who have formed societies for its improvement. The Bath and West of England Society, which still exists, has been greatly instrumental in spreading the knowledge of practical husbandry, and much useful information is contained in the Reports of its Transactions. The Highland Society of Scotland, of which all the principal proprietors and most of the large occupiers of land in Scotland are members, has greatly contributed to encourage experiments, and to promote improvements in every branch of husbandry.

The Board of Agriculture, at the head of which was Sir John Sinclair, the zealous promoter of all measures for diffusing agricultural information, although it has rather disappointed the hopes and expectations formed at its commencement, and has for some time ceased to exist, was the means of diffusing a knowledge of the state of husbandry throughout Britain, at the beginning of this century, by the publication of the Agricultural Surveys of the different counties, the substance of which has been condensed in the 'British Husbandry,' in 2 vols., lately published under the superintendence of the Society for the Diffusion of Useful Knowledge. The newly-established English Agricultural Society leads us to cherish the best hopes of a new stimulus being given to the improvement of British husbandry.

To complete this short sketch of British husbandry, it only remains briefly to mention the different systems which have been most prevalent at different times.

The first and most inartificial is that which consists in breaking up portions of pasture-land and sowing corn on a slight ploughing, which cannot fail to be productive for some time. Several crops may thus be taken, until the land is so exhausted that the crop no longer repays the seed and labour. To extend this time, experience soon pointed out the crops which succeeded best after each other. Wheat or barley were probably the first crops; afterwards peas, beans, or oats, until the ground, being overrun with weeds, would be left to the renovating effect of time, and a fresh spot would be broken up.

The first improvement on this system is that of infield and outfield. The infield is cultivated more carefully, somewhat like a garden, and all the dung of the cattle is exclusively put upon this part. The outfield is a continuation of the first-mentioned system. The infield consisted of inclosures or open fields near the dwelling, which it was most convenient to cultivate as arable land. Thus two distinct systems of husbandry were carried on at the same time; and whatever improvements were introduced in the management of the infield, the outfield continued to be managed as it was before.

The mode of recruiting lands which had been exhausted by crops, or were overrun with weeds, by means of a fallow, seems to have been introduced into England by the Romans, and never to have reached Scotland till the eighteenth century, a thing almost incredible, if it were not capable of explanation by the circumstance that there had generally existed a hostile spirit between the two nations, and that communications were not frequent between English and Scotch yeomen, except on the field of battle. The alternate crop and fallow seem to have been later introduced than a fallow after several crops. The triennial system, which consists of a summer fallow, a winter crop, and a spring crop, was probably longer established than any other, and is still the practice in many parts of England. The deteriorating effect of the outfield system would lead to its abandonment as soon as population increased, and with it the want of land for infield. The common-field lands, which were so extensive till within the last fifty years, many of which have since been inclosed by special acts of parliament, were probably at first only portions of commons, which were broken up by common consent, and formed into outfields. The right of pasture over them, after the crops are removed, strengthens this supposition.

When common-fields are divided and inclosed, a better system of husbandry generally follows. Clover and turnips are more regularly sown, and, on the light lands, take the place of summer fallow. Clover generally comes after a crop of corn, in which it was sown the preceding year in spring; and as most crops succeed well after clover, wheat was usually chosen for the next crop as the most profitable. Thus arose the Norfolk system, without any very sudden departure from the old rotations. Two crops raised for the food of animals in four years require more cattle on the farm to expend them profitably: and thus more manure is made. In the light soils the sheep when folded on the turnips not only enrich the land by their dung and urine, but likewise render it more compact by treading it, which is advantageous to the clover and wheat which come after. If the land is a good loam, beans are sometimes sown after wheat, the land having been recruited with manure; and if the beans are kept clean by hoeing, another good crop of wheat may be obtained after them. Thus arises the improved rotation of turnips, barley, clover, wheat, beans, wheat; after which the land is again cleaned and prepared for turnips with all the manure that can be spared. As in this system there is always a crop with succulent leaves intervening between two which have a white straw, it has been called the *alternate* system of husbandry. These are the most common systems in England. The removal of the fallow year, provided the land be kept clean, is a decided step towards improvement. The best farmers effect this by the introduction of artificial grasses and tares fed off by sheep, and especially by sowing every crop in rows and keeping the intervals stirred, which is a partial fallow without losing a crop. Here Tull's system is introduced, which in its complete state, as the author recommended it, was soon abandoned.

As the English systems have taken their origin chiefly from the infield cultivation, so the Scotch appear to have arisen from that of the outfield. Fallows were unknown; but the invigorating effect of grass fed off by cattle must soon have been perceived: and instead of leaving the land to recover slowly by the spontaneous growth of natural herbage, which on poor land takes a long time, it was obvious that this might be accelerated by sowing grass-seeds. Hence the origin of the Scotch convertible system of husbandry, which is gaining ground daily, and bids fair, in remote situations where no manure can be purchased, to be firmly established. The order of the conversion has been somewhat altered from what it was originally. Instead of sowing grass-seeds after the land is exhausted, it has been found advantageous to accelerate the growth of grass by manuring the crop in which it is sown; and experience has proved, that the richer the grass is, the more productive are the crops which come after. The grass, instead of being a mere substitute for fallowing and manuring, is made highly profitable by feeding cattle and sheep; and the profit of the years when the land rests, as it were, by being depastured, is often as great as that of the years when it is cropped; and the risk and expenses are much less. The convertible system is not very generally known or adopted in England, and is often confounded with the alternate system. The alternate system interposes a green crop between two white-straw crops. On good land the convertible husbandry may consist of three or four years' tillage and three years' grass. If the land is not quite clean, a summer fallow on heavy soils, or a turnip fallow on light soils, should begin the course; and only one crop should be taken after the fallow in which the grasses are sown, whether it be wheat, rye, barley, or oats. It should be fed off the first year, mown the second, and fed off again in the third: when it is broken up, oats are usually sown as the first crop in Scotland, then beans, if the land admits of them, and then wheat. If a fallow is intended, a crop of peas may be sown after the wheat, and then the course begins again, as before, with a clean fallow or with turnips. In this manner the land may be kept clean, and continually improve in fertility by means of the cattle which are kept upon it, without the aid of any purchased manure, except lime, the expense of which is in most cases well repaid by the crop. These are the only regular systems in Britain; and every mode of cultivation and cropping may be reduced to one of them, unless it be capriciously anomalous.

What renders the improved systems of British husbandry so superior to that of all other nations is the attention paid to the perfection of the different breeds of domestic animals, especially the horse, the ox, and the sheep. In this respect British husbandry surpasses every other. No expense or trouble is spared to improve the qualities of cattle and sheep. It has been objected, that the rewards given by different societies for excessively fat cattle are not judicious, as these animals are never profitable to the feeder. The same might be said of very high-bred racehorses; they are not so useful as a good hackney or hunter; but unless some individual animals possess the power, courage, and speed which is the mark of the best blood, it would soon degenerate; so likewise if some oxen were not occasionally fatted to an extraordinary degree, the fatting qualities of the breed could not be proved. A badly bred ox will never become so fat, whatever food may be given him, as one of a choice breed. This the breeders are well aware of, and never hesitate to pay a good price for a young bull related in blood to a prize ox.

The great variety of new instruments which are daily invented, and some of which gradually come into use, however expensive they may appear, is another feature in British husbandry; and the setting out of drills and thrashing machines, which are kept for profit by men who have little or no land to cultivate, is a step to that division of labour which has done such wonders in manufacturing industry, and which will no doubt in time do the same in the operations of husbandry. There is a fresh spirit of improvement arising among practical agriculturists, and not the least favourable symptom is, that it begins to be acknowledged that "much may yet be learned," and that "husbandry is still comparatively in its infancy." This admission is a great step towards improvement; and coupled with the establishment of the English Agricultural Society before referred to, leads us to hope with confidence that husbandry in Britain will improve rapidly, and keep pace with other sciences and arts.

Husbandry in Italy.—It might be expected that Italy would present some remains of the Roman husbandry; but such has been the pernicious effect of wars and intestine commotions, that this fine country, with all the advantages of soil and climate, is far behind less favoured regions in the cultivation of the soil and the rearing of cattle. The plains of Lombardy alone are an exception; but the cultivation of maize, the principal produce there, partakes more of the garden husbandry than that of any other grain. The abundance of water which descends from the Alpine regions fertilizes a great extent of soil by artificial channels, in which it is made to disperse itself, and produces a vegetation which requires little assistance, except that of weeding. Italy was however the country where, on the revival of letters, the first books were published on the practice of husbandry. Pietro di Crescenti, a citizen of Bologna, born in 1230, after thirty years' experience in all parts of Italy, wrote a treatise entitled 'Opus Ruralium Commodorum,' printed in 1474. There is a doubt whether it was first written in Latin or Italian, but it was soon translated into French and German. The author quotes Cato, Varro, and Palladius, but not Columella, who probably was not then generally known, or perhaps his works had not yet been rescued from the libraries in which antient works were long buried. In the succeeding century many of the Greek and Latin authors on husbandry were translated and published. Tavello, in his 'Recordo d'Agricoltura,' 1561, ascribes the deterioration of agriculture to the practice of letting land for three years only, which had been introduced very generally, and perpetuated the triennial system in its worst form. Johannes Baptista Porta, in 1592, published his 'Villæ,' in 12 books, a work which has had a considerable reputation, and is considered by many as still well worth consulting. A variety of authors on different parts of husbandry wrote about this time, in consequence of the frequent famines which arose in Italy from a very imperfect state of husbandry. The 'Vinti Giornate dell' Agricoltura,' Venetia, 1569, which had been first published in 1550, under the title of 'Deci Giornate,' went through more than 20 editions in Italy, besides being often translated. The author ridiculed the foolish astrological notions prevalent at the time, and his work is full of good sense. But all these writers had little influence on the improvement of the actual practice of husbandry in Italy. If a spirited proprietor attempted to introduce improvements, the prejudices and obstinacy of the country-people soon disheartened him, and to this day the systems adopted are extremely defective, if there is any system at all. In many places the ploughman still stands on the heel of the plough to keep it in the ground, and a straight furrow is not thought of. The earth is scratched rather than tilled; and if good crops arise from the natural fertility of the soil, they are generally choaked with weeds before harvest.

An attempt had been made by Leo X. to drain the Pontine marshes, and it was renewed in 1586 by Sextus V. Pius VI. spent great sums on the same object; but to this day little has been effected; and instead of the fertile plain which once was covered with a golden harvest, there is nothing but a dreary marsh producing pestilential vapours pregnant with disease. Sicily and Sardinia, once the granaries of Rome, now produce only a very small quantity of corn. The best cultivated districts in Italy are Piedmont, Lombardy, Tuscany, and the country about Ferrara; but, except in the two first, they are behind the rest of Europe in the management of a farm. The proprietor of the land, if he does not cultivate it by his own servants, is also the proprietor of all the live stock and implements of the farm.

Husbandry of Spain.—Spain possesses a considerable extent of fruitful soil, and the husbandry of the Romans, which the irruption of the barbarians had interrupted, was in some measure revived by the Moors. When they were expelled, Spain lost many industrious husbandmen and manufacturers. A work on husbandry by a Moor, called Ebd-el-awam, who is supposed to have lived about the thirteenth century, was published with a Spanish translation at Madrid in 1802, and does credit to the agricultural knowledge of the author. The cultivation of the sugar-cane and of saffron are mentioned in this work.

Herrera, who wrote on husbandry at the desire of Cardinal Ximenes, is one of the most esteemed authors of his time. His works have been frequently republished; and are now in great reputation, and looked upon as quite classical in agricultural literature. He laments that mules are generally used in Spain for the plough and other purposes of husbandry, instead of the ox. But Herrera did not succeed in changing the custom; and mules are still in general use. The great object of attention in Spain is the production of fine wool; and the privileges given to the Mesta, a kind of corporation of shepherds, tend greatly to retard the introduction of a better cultivation. The Merino breed of sheep is said to have been imported originally from Britain. But it is evident that, if it is necessary to its perfection that the flocks should run over half the kingdom every year, the profit which is made by the exportation of fine wool is dearly purchased by the disadvantages of a miserable state of agriculture. Instead of producing a superabundance of grain and supplying other countries, Spain is obliged frequently to import corn in order to prevent a scarcity. The state of Portugal is not better, and the vine is the only plant of which the cultivation is moderately well understood in the whole of the Peninsula.

Husbandry of Germany.—The husbandry of Germany varies greatly in such an extent of country. In the time of Tacitus half the country was covered with impenetrable woods. As population extended, the forests were cut down, and the sickle succeeded to the axe. The republic of the Swiss cantons and the Hanseatic towns gave the first examples of encouragement to husbandry. In 1571 the work of Heresbach, entitled 'Rei Rusticæ Libri IV.,' was reprinted at Cologne. Heresbach was born in the duchy of Cleves in 1509, and is considered the father of husbandry in Germany.

Augustus I., elector of Saxony, wrote a treatise on the cultivation of the vine, which was published in 1636, entitled 'Churfürsten's Augusti zu Sachsen Obstgartenbuchlein.'

In Prussia, Mecklenburg, and Holstein husbandry has made the greatest progress in modern times. The Prussian government, from the time of Frederick the Great, has taken agriculture under its especial protection. In Prussia there are several schools of agriculture, where this art is taught on scientific principles, and where the practice is shown on large farms. That of Mögelin, over which A. Thaer presided, has become conspicuous from the excellent work on Rational Husbandry, 'Rationellen Landwirthschaft,' which he published. The introduction of the Dutch system of dairying into Holstein, and the breeding of fine horses there, has given a reputation to this part of the Danish dominions. In Bavaria, along the banks of the Rhine, from Basel to Darmstadt, there is a fine fertile plain which is cultivated with some care; and although subjected generally to the triennial system (which is called in England the three-course shift), the husbandry of that part of Germany is not to be despised. In Switzerland the management of grass-lands and water-meadows is carried to great perfection. The cultivation of lucern and sainfoin is very general; potatoes are raised to a very considerable amount; and the soiling of cattle in the stables is universal. The scientific writers of Geneva have contributed greatly to throw light on the theory of vegetation; and it is scarcely necessary to mention Theodore de Saussure, Pictet, De Candolle, and Macaire as men who have contributed more than any others to explain the functions of vegetable life.

As a practical promoter of husbandry we cannot pass over M. de Fellenberg at Hofwyl, near Bern. On an estate of about three hundred acres he has put in practice all that has been written by the most esteemed writers, taking Thaer as his text-book, and making himself acquainted with the best modern writers. He has established an agricultural school for poor children, which is a part of his great plan for general education, and which will contribute more to promote good practical husbandry in his native country than all the works of the most eminent writers.

Belgium has always been foremost among agricultural countries. In 1680 the Flemings were considered the best husbandmen in Europe. There are no early writers on husbandry in this agricultural nation, but all travellers bear witness to their industry and to the perfection of their agriculture. They were probably the first in modern times who cultivated turnips in the field to feed cattle in winter; and who, in the north of Europe, kept their cattle in the stables all the year round and cut green food for them, as had been done from time immemorial in southern climates, on account of the excessive heat of the day and the annoyance of flies. The Belgians are now far advanced beyond most other nations of Europe in the application and economy of manure. They fully make up by incessant attention and indefatigable industry for the inferiority of their climate to that of Italy or Spain, and their land produces abundantly every necessary of life. [Flanders Agriculture.]

Husbandry of France.—France has always been looked upon as a country peculiarly agricultural. The climate, partaking of that of the north and the south, favours the cultivation of plants both of the warmer and of the colder regions; and there is no country where husbandry has been so much protected, or where more good works on husbandry have been published, without producing any very sensible effect on the general practices of the husbandmen. Charles Estienne is the first French writer on agricultural subjects whose works were published soon after the revival of letters; but together with many useful maxims which he has copied from the antient authors, he has repeated the most absurd superstitions. His works were collected and published in 1554, under the title of 'Prædium Rusticum,' and in 1565 he published his work called 'L'Agriculture et la Maison Rustique.' This work was reprinted with additions by his son-in-law Jean Libeaut, in 1570. But the author who is still considered as the father of French husbandry is Olivier de Serres, a gentleman of fortune, proprietor of the seigneurie of Pradel, near Villeneuve de Berg, in Languedoc. He was a friend of Sully, the favourite minister of Henri IV., and, at his request, about the year 1600, he wrote a work on husbandry, under the title of 'Théâtre d'Agriculture et Mesnage des Champs.' In this work he shows a thorough knowledge of the great principles of husbandry; and he gives rules and directions which, if they had been generally followed, must have advanced the agriculture of his country at least two centuries. But it is a general remark, that where there have been most good books written on the subject of husbandry, there the practice has derived least advantage from them. While France swarms with agricultural writers, the fields are still cultivated as they were centuries ago; and the Flemings, who never write on the subject, have for ages carried husbandry to the greatest perfection.

Of those who have written on husbandry, one of the most zealous and practical authors is Rozier, an ecclesiastic who devoted his life to this favourite pursuit. His 'Cours Complet d'Agriculture' is a text-book for all those who, within the last half-century, have desired to become acquainted with the principles of husbandry. It has gone through several editions, and forms the groundwork of another 'Cours Complet,' which has been published by a society of writers on husbandry, and is now the best French work on every department of husbandry and cultivation.

There is now in France and throughout Europe a great desire to promote practical improvement in husbandry. Agricultural schools and veterinary colleges are multiplied; and the return of peace, if its blessings can be duly appreciated and maintained, cannot fail greatly to encourage the application of capital and skill to the improvement of that art which furnishes the staff of life.

IRRIGATION. Of all the substances which concur in the vegetation and growth of plants, water is the most essential; without moisture the seed cannot germinate, nor can the plant receive nourishment. Hence in warm climates, where rains are periodical, and where the soil is dried and parched by a continued evaporation, no verdure exists, except where springs or rivers supply the waste of moisture. The warmer the climate, and the more rapid the evaporation, the more luxuriant is the vegetation, provided there be an abundant supply of water. This circumstance has suggested the plan of diverting streams and conducting them in channels to fertilize as great an extent of land as possible.

In China and in India, as well as in Egypt, ingenious modes of watering lands have been adopted from the most remote ages. No expense has been thought too great to secure a supply of water, and to distribute it in the most advantageous manner. It seems that where there is great heat in the air, water alone will supply the necessary food for the growth of plants. It is probable that the component parts of the atmosphere are more easily separated, and made to enter into new combinations with those of water, in a high temperature than in a lower; or that the leaves and green parts of vegetables imbibe water in a state of solution in air, and that in this state it is more easily decomposed. Atmospheric air and water contain all the principal elements of vegetables, viz. oxygen, hydrogen, carbon, and nitrogen; the remainder are either found in the soil or diffused through the water. Manures seem to act principally as stimulants or re-agents, and are themselves composed of the same elements: they are of no use unless diffused or dissolved in water; but when the water is impregnated with animal or vegetable substances, the effect is far greater and more rapid than when the water is pure.

Water has also an important office to perform, if we admit the principle discovered by Macaire, that plants reject through their roots those portions of the sap which are the residue of its elaboration, and which are of no further use to the plant, but rather injurious if they are again imbibed by the roots. Plants seem to require a removal of their excrements, as animals do when tied up in stalls or confined in a small space. If this is not effected, they suffer and contract diseases. The percolation of water through the soil is the means which nature has provided for this purpose. Hence we can readily suppose that the mere washing of the roots has a beneficial effect, and to this in a great measure must be ascribed the fertilizing effects of pure and soft running water.

If water stagnates and is evaporated, and the noxious matter held in solution remains in the soil, all the advantage of irrigation is lost, and the better kinds of grasses are succeeded by rushes and coarse aquatic plants, as may be seen in all marshy spots. The circulation of the water therefore appears to be as necessary as its presence; and, provided there be a sufficient supply of water of a proper quality, the more porous the soil, and especially the subsoil, is, the more vigorous is the vegetation. It is on this principle alone that we can rationally account for the great advantage of irrigation in those climates where rain is abundant, and where the soil, which is most benefited by having a supply of water running through it, is of a nature to require artificial draining as an indispensable preliminary to being made fertile by irrigation. By keeping these principles in view great light will be thrown on the practical part of irrigation, which, having been long established by experience, before these principles were thought of, depends not on their correctness, but only confirms their truth.

The whole art of irrigation may be deduced from two simple rules, which are, first, to give a sufficient supply of water during all the time the plants are growing, and, secondly, never to allow it to accumulate so long as to stagnate. We shall see hereafter one apparent exception to this last rule, but it will be readily explained.

The supply of water must come from natural lakes and rivers, or from artificial wells and ponds, in which it is collected in sufficient quantity to disperse it over a certain surface. As the water must flow over the land, or in channels through it,' the supply must be above the level of the land to be irrigated. This is generally the principal object to be considered. If no water can be conducted to a reservoir above the level of the land, it cannot be irrigated. But there must also be a ready exit for the water, and therefore the land must not be so low as the natural level of the common receptacle of the waters, whether it be a lake or the sea, to which they run. The taking of the level is therefore the first step towards an attempt to irrigate any lands.

Along the banks of running streams nature points out the declivity. A channel, which receives the water at a point higher than that to which the river flows, may be dug with a much smaller declivity than that of the bed of the river, and made to carry the water much higher than the natural banks. It may thence be distributed so as to descend slowly, and water a considerable extent of ground in its way to rejoin the stream. This is by far the most common mode of irrigation, and the shape, size, and direction of the channels are regulated by the nature of the surface and other circumstances, which vary in almost every situation. A few examples will give to those who are not acquainted with the best modes of irrigating land a pretty accurate notion of the system.

We shall suppose a river to run with a rapid current between high banks. At some point of its course a portion of the water is diverted into a canal dug along the bank, with a very small declivity. The water in this canal will flow with less rapidity than the river, but will keep the same level as that part of the river where it has its origin. Thus the water may be carried over lands which are situated considerably above the bed of the river farther down. All the lands between this canal and the river may be irrigated, if there is a sufficient supply of water. The canal may be carried to considerable distance from the river. The size of the canal and its declivity depend on the quantity of water which may be made to flow into it. A dam is often constructed across a river, in order that as much of its water as is possible may be diverted, and the original channel is often laid quite dry, to take advantage of all the water at the time when it is advantageous to irrigate the land. To have an entire command of the water there are flood-gates on the main channel and on the lesser branches. By opening or shutting these, the water may be stopped or made to flow as may be required. It must be remembered, that to carry water to a considerable distance, and in great quantity, a larger channel and more rapid declivity are required; and it is a matter of calculation whether it is most advantageous to bring a smaller quantity to a higher point, or a greater abundance somewhat lower. Having a certain command of water, it may be carried from the main channel by smaller branches to different points, so as to irrigate the whole equally. These branches should be nearly horizontal, that the water may overflow the sides of them, and be equally distributed over the land immediately below. Every branch which brings water over the land should have a corresponding channel below to carry it off; for the water must never be allowed to stop and stagnate. When it has run 15 or 20 feet, according to the declivity, over the land situated below the *feeder*, or the channel which brings the water, it should be collected into a drain to be carried off, unless it can be used to irrigate lands which lie still lower. Finally it runs back into the river from which it was taken, at a lower point of its course.

When there is a considerable fall and a sufficient supply of water, a series of channels may be made, so situated below each other, that the second collects the water which the first has supplied, and in its turn becomes a feeder to irrigate the lower parts of the declivity: a third channel receives the water and distributes it lower down, until the last pours it into the river. This is called *catch-work*, because the water is caught from one channel to another. This method is only applicable where there is a considerable fall of water and a gentle declivity towards the river. But it must be borne in mind that the water is deteriorated for the purpose of irrigation, when it has passed over the land, and that it is not advantageous to let it flow over a great extent when a fresh supply can be obtained: but where only a small portion of water can be commanded, that must be made the most of; and it will irrigate three or four portions of land in succession without there being any very marked difference in the effect: beyond this it rapidly loses its fertilizing qualities. This is not owing to the water having deposited the fertilizing substances which it held in solution, or which were diffused through it, but it is owing to its having taken up some which are detrimental to vegetation, and being saturated with them: at least this is the most probable opinion when all circumstances are taken into the account.

The general principle of irrigation may be described as the supplying of every portion of the surface with an abundance of water, and taking it off again rapidly. In many situations the great difficulty in irrigation arises from the want of a supply of water; but even then a partial irrigation may be effected, which, although not perfect, will have its advantages. A small rill, which is often quite dry in summer, may still by judicious management be made to improve a considerable portion of land: its waters may be collected and allowed to accumulate in a pond or reservoir, and let out occasionally, so that none be lost or run to waste. If there is but a small quantity, it must be husbanded and made to flow over as great a surface as possible. If there is water only at particular seasons of the year, and at a time when it would not be of much use to the land, it may be kept in ponds, and it will lose none of its qualities by being exposed to the air. If animal or vegetable matter in a partial state of decomposition is added to this water it will much improve its quality, and by a judicious distribution of it over the land a great benefit may be obtained.

If there is not a want of water, there may be a want of declivity to enable it to flow off, which, it should always be remembered, is an essential part of irrigation. Art may in this case assist nature by forming a passage for the water, either in its course towards the land to be irrigated, or from it after it has effected its purpose. Where there is no natural exit, and it might lead to too great an expense to make an artificial one, the water may sometimes be led into shallow ponds, where a great part is evaporated; or porous strata may be found by boring, into which it can be made to run and be dispersed. Along rivers where the fall is very imperceptible a channel brought from a considerable distance may give such a command as to throw the water over a great extent of surface; and to carry it off another channel may be cut, emptying itself at some distance below; so that lands which lie along the banks of a river may be irrigated, although they are actually below the level of the river, and require banks to protect them from inundation.

When the surface to be irrigated is very flat and nearly level, it is necessary to form artificial slopes for the water to run over. The whole of the ground is laid in broad beds, undulating like the waves of the sea. The upper part of these beds is quite level from end to end, and here the channel or float which brings the water on is cut. From the edge of this channel the ground is made to slope a foot or two on both sides, and a ditch is cut at the bottom parallel to the float. The whole of the ground is laid out in these beds. All the floats are supplied by a main channel at right angles to the beds, and somewhat above them, and all the ditches or drains run into a main ditch parallel to the main float, and below the lowest drain. The course of the water is very regular. As soon as the flood-gates are opened it flows into all the upper channels, which it fills till they overflow in their whole length. The sloping sides are covered with a thin sheet of running water, which the lower drains collect and carry into the main ditch.

Experience has shown that there are particular seasons when the water has the best effect; a perfect command of it is therefore indispensable, and also a regular supply. During frost, when all dry meadows are in a state of torpor, and the vegetation is suspended, the water-meadows, having a current of water continually flowing over them, are protected from the effect of frost, and the grass will continue to grow as long as the water flows over it. Too much moisture, however, would be injurious, and the meadows are therefore laid dry by shutting the flood-gates, whenever the temperature of the air is above freezing. By this management the grass grows rapidly at the first sign of spring. Before the dry upland meadows have recovered the effects of frost and begun to vegetate, the herbage of the water-meadows is already luxuriant. As soon as they are fed off or cut for the first crop of hay, the water is immediately put on again, but for a shorter time; for the warmer the air, the less time will the grass bear to be covered with water. A renewed growth soon appears, and the grass is ready to be cut a second time when the dry meadows only give their first crop. Thus, by judicious management, three or four crops of grass are obtained in each season, or only one abundant crop is made into hay, and the sheep and cattle feed off the others. The usual way in which the grass of water-meadows is made profitable is by feeding ewes which have early lambs till the middle of April. A short flooding soon reproduces a crop, which is mown for hay in June; another flooding gives an abundant aftermath, which is either mown for hay, or fed off by cows, bullocks, and horses; for at this time the sheep, if pastured in water-meadows, are very subject to the rot. The value of good water-meadows could scarcely be believed by those who are not familiar with them. Where the water is suited to irrigation they never require manuring. The fertility is kept up continually, and the only attention required is to weed out coarse aquatic plants, which are neither nutritious nor wholesome in hay or pasture.

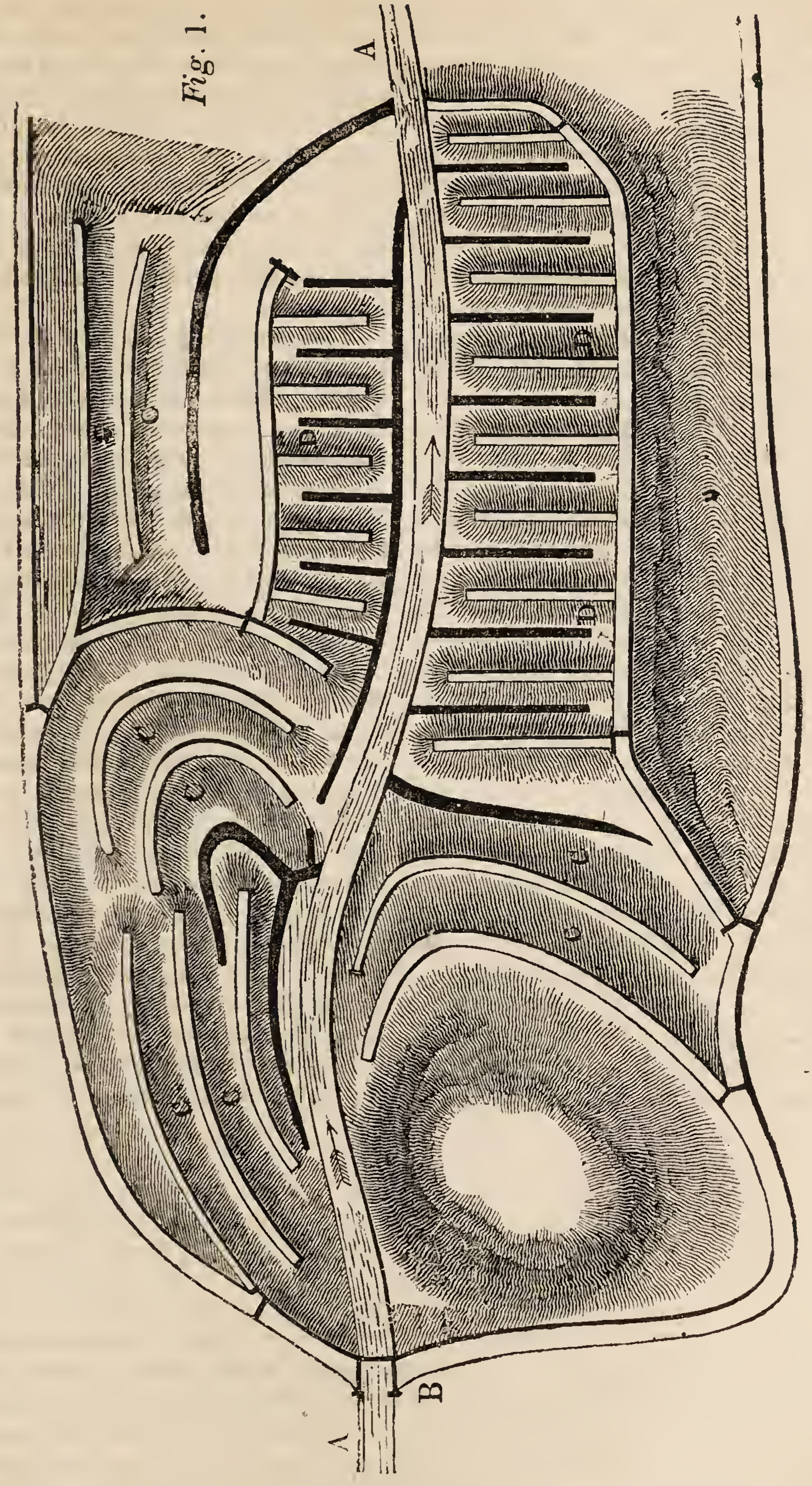
The best soil for a water-meadow is a good gravel. The finest water-meadows on the Avon in Wiltshire, where the richest herbage is found, have scarcely any soil at all, but are on a bed of shingle and pebbles matted together by the roots of the grass, which proves to demonstration that the waters of the Avon contain all the principles essential to rapid vegetation. Great attention is required, and some experience, to irrigate meadows so as to give the greatest profit.

In hot weather, when we should imagine that the land must be thirsty, and that too much water cannot be poured over it, much mischief may be done by injudicious flooding. In winter, on the contrary, the land may be covered with water for weeks without injury; and if an earthy deposit takes place, the subsequent fertility is greatly increased. But this is not properly irrigation: it is inundation, and the effects depend on entirely different causes. When low meadows are inundated in winter and spring, it is the muddiness of the water which enriches the land: a fine layer of extremely divided matter is deposited, and when the water subsides this acts as a coat of manure.

Water may be carried in small channels through meadows without being allowed to overflow, and in this case the effect is similar to that caused by rivers or brooks which wind slowly through valleys, and produce a rich verdure along their course. This is watering, but not properly irrigating. When this is done judiciously, the effect is very nearly the same as when the land is irrigated; and in hot climates it may be preferable, by giving a constant supply of moisture to the roots, while the plants are growing. The great advantage of water-meadows in England is not so much the superior quantity of grass or hay which is obtained when they are mown, as the early feed in spring, when all kinds of nutritive fodder are scarce; when the turnips are consumed before the natural grass or the rye sown for that purpose is fit to be fed off, the water-meadows afford abundant pasture to ewes and lambs, which by this means are brought to an early market. The farmer who has water-meadows can put his ewes earlier to the ram, without fear of wanting food for them and their lambs in March, which is the most trying season of the year for those who have sheep. At that time an acre of good grass may be worth as much for a month as a later crop would for the remainder of the year. When it is intended to form a water-meadow on a surface which is nearly level, or where a fall of only two or three feet can be obtained in a considerable length, the whole of the land must be laid in beds about 20 or 30 feet wide, the middle or crown of these beds being on a level with the main feeders, and the bottoms or drains on a level with the lower exit of the water, or a little above it. To form these beds most expeditiously, if the ground is already in grass, the sod may be pared off and relaid after the beds are formed, by which means the grass will be sooner re-established; but except in very heavy soils, where the grass is some time in taking root, the easiest and cheapest way is to plough the land two or three times towards the centre, and dig out the drain with the spade: the earth out of the drains, and that which is taken out of the upper trench or feeder, may be spread over the bed to give it the proper slope. A roller passed over the bed in the direction of its length will lay it even, and the seeds of grasses being sown over it, the water may be let on for a very short time to make them spring. As soon as the grass is two or three inches above ground a regular flooding may be given, and in a very short time the sward will be complete. Instead of sowing seed, tufts of grass cut from old sward may be spread over the newly formed beds, and they will soon cover the ground. The Italian rye-grass, which has been lately introduced into this country from Lombardy and Switzerland, grows so rapidly, that if it be sown in February, or as soon as the snow and frost are gone, it will afford a good crop to feed off in April, or to mow for hay by the beginning of May; and after that it may be cut repeatedly during the summer. But where the soil is good and the water abundant, good natural grasses will spring up without much sowing, and soon equal the old water-meadows.

It seems essential to the formation of a good water-meadow that the bottom be porous and free from stagnant water; hence under-draining is often indispensable before a water-meadow can be established; and a peat-bog, if drained and consolidated, may have water carried over its surface, and produce very good herbage. If the soil is a very stiff clay, draining is almost indispensable where a water-meadow is to be made. The more porous the soil the less depth of water is required, which is not obvious at first sight; but the clay lets the water run over the surface without soaking into the roots, whereas the porous soil is soon soaked to a considerable depth. The water must therefore be longer on the clay than on the sand or gravel to produce the same effect. If the water is properly applied, all kinds of soils may converted into fertile water-meadows. On very stiff clays a coat of sand or gravel, where it can be easily put on, will greatly improve the herbage. It should not be

Fig. 1.



ploughed in, but laid on the surface two or three inches thick: chalk will also improve the herbage.

The usual time of letting on the water on water-meadows is just before Christmas, and it may continue to flow over the land as long as the frost lasts: in mild weather it may be turned off during the day and put on again at night until the frost is gone. The grass will soon begin to grow, and be ready to be fed off. When this is done, the water is immediately let on for a short time, and turned off again to allow the ground to dry after a few days' flooding, and the water is let on again at short intervals. The warmer the air is, the shorter time must the water be allowed to cover the meadows. As soon as the grass is five or six inches long it must be left dry entirely till it is mown or fed off. In summer the floodings must be very short, seldom more than twenty-four hours at a time, but frequent. Thus a great weight of grass may be obtained year after year without any manure being put on the land, care being taken that where the surface is not quite even the hollows be filled up with earth brought from another place, or dug out of the drain, if that should be partially filled up with the soil which the water has carried into it. We alluded before to a case where water may remain a considerable time on the land without injury; this is, when there are inundations from rivers, which rise above their beds in spring and cover the low meadows which lie along their banks. In this case the grass, which had not yet sprung up, is protected from the cold, and if there is a deposit from the water there is a considerable advantage. But when it subsides, it must be made to run off entirely, without leaving small pools, by which the grass would invariably be injured. Small ditches or channels are usually dug, by which all the water may run off, unless where the subsoil is very porous, or the land is well under-drained, which is seldom the case in these low meadows, for the drains would be apt to be choaked by the earthy deposit from the water. These inundations can sometimes be regulated by means of dykes and flood-gates, in which case they partake of the advantages of irrigation, and also of that deposition of fertilizing mud which is called warping. [WARPING.]

The preceding plan (*Fig.* 1) will explain what has been briefly said respecting the different modes of irrigating land. A A is a river which has a considerable fall, and then flows through a level plain. A considerable channel is cut at B, where there is a rapid fall over a natural or artificial dam. This channel is carried round a hill and supplies a series of channels, C, C, C, placed below each other, forming catch-work along a declivity. A portion of the water goes on to D, where it supplies the feeders of a regular set of ridges, or beds, made as before described, from which the water returns into the river by a main trench, into which all the drains run.

On the other side of the river, where the slopes lie somewhat differently, there are several examples of catch-work, the black lines representing the drains which receive the water after it has flowed over the surface and carry it into the river below. It is evident that all the feeders are nearly horizontal, to allow the water to flow over their sides.

Fig. 2.

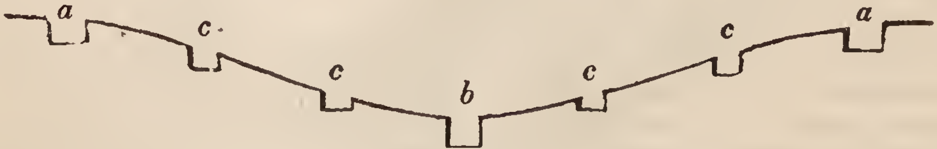
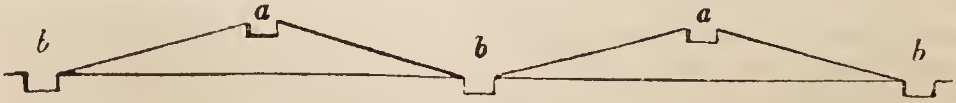


Fig. 2 is the section of catch-work. *a*, *a*, are the feeders; *b*, the drain; *c*, *c*, *c*, *c*, intermediate channels which acts as feeders and drains.

Fig. 3.



Ridge-work.

Fig. 3 is the section of two adjoining ridges. *a*, *a*, the feeders; *b*, *b*, *b*, the drains.

Fig. 4.

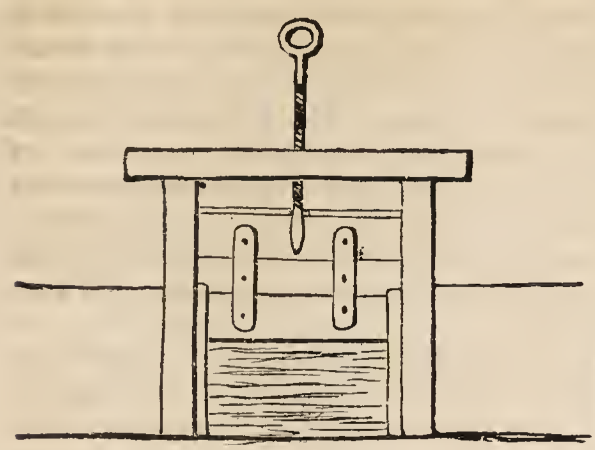


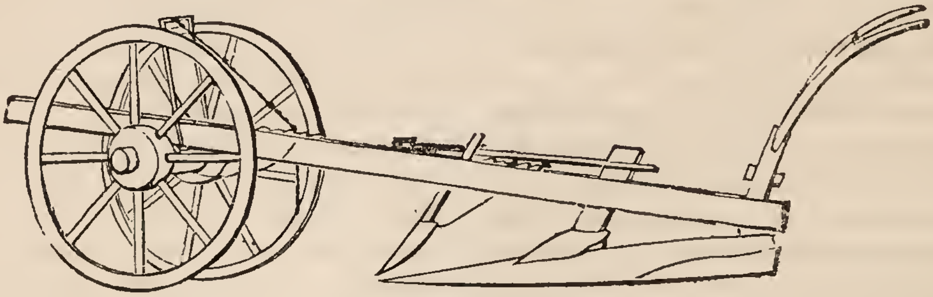
Fig. 4 is a sluice to regulate the flow of water.

KENT AGRICULTURE.—The climate of Kent is in general mild and genial. The proximity to the continent of Europe exposes it to occasional north-east winds, which chill the air, but they carry off the superfluous moisture of the soil; and some of the most fertile spots are in the Isle of Thanet, which lies at its north-eastern extremity, and in the adjacent parts. The soil of this county may be divided into the gravel, chalk, and clay, which produce, where they mix in due proportions, an extremely fertile loam. The alluvial soils along the Thames and Medway, and in Romney Marsh, produce some of the richest marsh pastures in the kingdom.

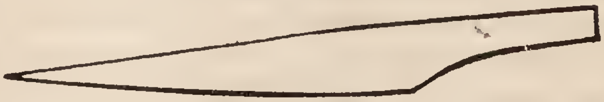
A ridge of hills composed of ragstone traverses the county from west to east, along which there are some very fertile clays, which, with moderate attention to the cultivation, are highly productive. The chalk, which lies chiefly to the north of these, rises into hills between Canterbury and Dover, where there are some extensive sheep-downs, but from Canterbury towards London it is mostly covered by a stiff clay, and only breaks out here and there on the banks of the Thames. To the south of the ragstone hills are the Wealds, which contain some very fertile clays and woods, in which oaks grow to a great size. The soil in the Isle of Thanet is not naturally so fertile as the appearance of the crops might lead one to suppose. It consists mostly of a thin light soil; but it has been so long improved by careful cultivation and abundant manuring, chiefly with sea-weed, that it may now be considered one of the most fertile spots in Great Britain. The subsoil is everywhere a hard chalk, over which there is in some places a thin layer of earth mixed with flinty pebbles, not exceeding six or eight inches in depth: in some of the hollows the soil is deeper and more loamy, and so dry as to allow of its being ploughed quite flat without any ridges or water-furrows. There is not an acre of waste land in all the Isle of Thanet.

Throughout the whole county the clay may be said to predominate, and the mode of cultivation generally adopted is that which suits the strongest soils. The Kentish farmers and yeomen, though generally rich and independent, are not very ready to introduce improvements in the system by which their forefathers were enriched; and although a great quantity of corn is annually raised in the county, and contributes a great portion of the supply of the London market, it cannot be denied that this produce might be greatly increased, and raised at a less expense than it is now, by adopting improvements in the tillage of the land and the implements in use. An old Kentish farmer may perhaps smile at this assertion, and, looking at his fine fields of wheat and beans, defy any one to cultivate the land better. This is the very reason why improvements which have been introduced in less productive districts have made little or no progress in this county. In the year 1793, Mr. John Boys, who drew up the general view of the county of Kent, being himself a Kentish farmer, mentioned the heavy turn-wrest plough, used almost universally throughout Kent, as " drawn by four horses on the lightest soils, and with six on all the stiffest;" and at this day, nearly half a century later, the old heavy turn-wrest plough is still used with four horses in soils where a good plough of an improved form would readily do the same work with two.

The Kentish turn-wrest plough consists of a beam ten feet long, five inches deep and four broad, behind which is a foot five inches by three and a half, and three and a half feet long, on the top of which the handles are fixed. Through the beam, at two feet five inches from the foot, is a sheath of oak seven inches wide and one and a half thick, which is morticed into the chep in an oblique direction, so that the point of the share is twenty-two inches distant from the beam. The chep, to which the share is fixed, is five feet long, four inches wide, and five inches deep. The share is of hammered iron, weighs about 32 pounds, is twenty inches long, and from four and a half to seven inches wide at the point. The upper end of the beam rests on a carriage with two wheels three feet two inches high: on the axletree is a gallows, on which is a sliding bolster to let it up and down. Through the centre of the axle is a clasp-iron, to which is fixed a strong chain called a tow. This comes over the beam, and, by lengthening it, the beam is let out a greater length from the axle, and thus the plough goes to a greater depth in the ground; by shortening it the reverse takes place.



Turn-wrest Plough.



Share of the turn-wrest Plough. The point is flat, like a chisel, for stiff clays, and with a blunt point for stony soils.

We do not mean to disparage this plough for heavy soils, nor doubt the necessity of its being drawn by four horses in some very stiff clays; but it might be greatly improved, and the draught diminished, so as to save at least one horse in four. In clay soils, which are retentive of water, it is always advantageous to lay the land in stitches with deep water-furrows between them; and for this purpose the Suffolk or the Scotch ploughs with a fixed turn-furrow are much better adapted than the turn-wrest.

On the soils in the Isle of Thanet, where wheat and beans are raised alternately without fallow or intermission, the practice is good, and, if effected at a moderate expense, is not to be found fault with. The ground is well stirred and amply manured for the beans, which are drilled in rows with wide intervals, and repeatedly horse-hoed till the crop is too far advanced to admit of it. The returns cannot fail to be good. The bean stubble is cleared of the stems and roots of the beans by a plough with a very broad share, which effects a perfect hoeing and leaves the surface quite clean. A deep ploughing is then given for the wheat. We cannot suggest any improvement in this practice, unless it b in the economy of the labour. But such soils are very scarce, and much of the Kentish clays and loams must be cultivated with a greater variety of crops. There is room here for improvement, both in the rotations and in the manner in which each crop is raised; and the Kentish farmer might find it profitable to adopt some of the methods which experience has fully proved to be advantageous in soils and situations not so well adapted to them as many parts of Kent are. A journey through the northern counties of England and the south of Scotland would give the young Kentish farmer some useful hints, and would remove some prejudices which impede his progress in agriculture.

Besides the usual crops which are raised on good clays, Kent produces several which are peculiar to it, such as canary and radish seed, which grow chiefly in the Isle of Thanet, where there are few hedge-rows to harbour birds, which are very destructive to these crops. The canary seed is cut in September, and is left for some time in the field until it is fit to be thrashed; for the seed adheres so strongly to the husk that it requires the influence of rain and exposure to the weather for some time to destroy the texture of the envelopment before it can be separated; and it suffers very little from this exposure. The produce is from three to five quarters per acre, and is chiefly used to feed birds kept in cages, and for this purpose is largely exported. The offal is very good food for horses. Radish seed is also cultivated in the richer sails for the London seedsmen. It is sown in drills and carefully hoed, so as to leave the plants eighteen inches asunder. The pods, when ripe, require to be left long in the field before the seed can be thrashed out. The produce is from eight to twenty-four bushels per acre. The demand for this seed is very great: every garden, however small, has a bed of radishes, and few gardeners think it worth while to save the seed.

Other seeds are likewise raised for the London seedsmen, such as spinach, cresses, and white mustard. Kidney beans are cultivated to a considerable amount in the neighbourhood of Sandwich, and produce from ten to twenty bushels per acre.

Woad and madder were formerly more commonly cultivated in Kent than they are now; the foreign, being raised at a less expense, has driven the Kentish out of the market. With a greater attention to the management of these valuable crops, they might probably still be raised advantageously; but everything which is done in Kent is done in a more expensive manner than in many other countries; a great proof of the easy circumstances of the farmers and landowners there.

There is comparatively a very small proportion of grass land in Kent, if we except the sheep-downs on the chalk hills and the marshes. The marshes produce most of the hay consumed in winter. Romney Marsh, which is well known for the richness of its grass, contains about 44,000 acres; on the borders of the Stour are 27,000; and along the Medway, Thames, and Swale, about 11,500 more. A great many sheep are reared and fattened in these marshes. The cattle fed there are only a secondary consideration, sheep being found more profitable. The quantity of sheep which the land will keep varies from two to five per acre; sometimes the grass grows faster than the flock can consume, and becomes too rank, a circumstance which is owing to want of attention in stocking, and is detrimental. Lean cattle are then taken in to eat it close; but a careful farmer never allows his marshes to be either over or under stocked, and keeps the grass close fed and yet abundant. The hay made in the marshes is often stacked in the marsh itself, near some shed, where the stock may be supplied in winter.

There are very few dairies of any consequence in Kent, nor is any cheese made, except for domestic consumption.

Hops are grown to a very great extent in this county; and, with the exception of those which are raised at Farnham in Surrey, are the most esteemed of any in England. [Hops.]

In that part of Kent which is nearest to London there are many extensive gardens; and about Deptford hundreds of acres are laid out in asparagus beds. Great quantities of peas are also raised for the London market on the line of road from London to Rochester. Apples, pears, plums, and cherries are raised in orchards, and the produce sent to the London market. Cider is also made in considerable quantities. In some places hops, apples, cherries, and filberts may be seen growing together in the same grounds; the proportion is 800 hop hills, 200 filberts, and 40 apple or pear trees per acre. The hops last twelve years, the filberts thirty; after which the apples and pears require the whole ground. This is a very good arrangement, by which the land is constantly producing.

The cultivation of the filberts is peculiar to Kent, and very well managed there, especially in the neighbourhood of Maidstone. They do not require a very rich soil, but grow well in that which is rocky and gravelly. The ground is kept clean around the trees, which stand about twelve feet apart. They are very carefully pruned, and one stem only is left to branch out a few inches above the ground; the branches are trained and pruned in the shape of a punch-bowl, and are not allowed to run above four or five feet high: thus they will bear abundantly, and be very profitable. When the filberts are gathered, they are laid to dry in the sun or under a shed exposed to the air. If they are well dried, they will keep good for several years.

There are still some extensive woods in Kent, but they are diminishing every year; and the produce of bark and timber is much reduced from what it formerly was. The demand for hop-poles has caused more attention to be paid to underwood; and some of the coppices, which are well managed, give a sufficient return to prevent their being grubbed up and converted into arable land.

On a general review of the agriculture of this county, it may be observed, that notwithstanding its present productive state, and the natural fertility of many parts, it is capable of very great improvement, and that by a little attention, and a judicious outlay of capital in draining and liming where it is required, and especially by a more economical application of agricultural labour, both in men and horses, its produce might be greatly increased, and raised at much smaller expense than it is at present.

LANCASHIRE AGRICULTURE.—The climate of Lancashire is mild and moist. The high hills which run along its eastern boundary shelter it from the cold easterly winds, but at the same time arrest the clouds which come from the Atlantic, and produce more abundant rains than in other eastern parts of England.

The surface of the county is very uneven in the northern and eastern parts. Near the coast the land is level, and the soil consists of a good sand over a rocky subsoil, or a clay marl, which, when mixed with the upper soil, renders it extremely productive, especially in garden vegetables. There are extensive tracts of peat-moss, but few very stiff cold clays, which abound in many other parts of England, and are very expensive in the cultivation.

From the moist nature of the climate Lancashire is more productive in grass than in corn. The arable land is well cultivated wherever sufficient encouragement is given to the tenant by granting a lease for a considerable term. Many of the farms are considerable, and were formerly occupied as domains by the larger proprietors. Several still retain the name of Hall or Manor Farm, but the subdivision of property has given rise to very small occupations, which are cultivated like large gardens, and are very productive, especially the sandy loams, where excellent crops of potatoes are raised. The course of tillage has improved of late years in the larger farms; but it was far from being good when the Agricultural Survey of the county was published in 1795. The more fertile the soil the worse was the cultivation of it, crop after crop being taken without much attention being paid to manuring and cleaning the land. Oats have always been a favourite crop, partly from their suiting a moist climate, and from their forming a considerable part of the food of the inhabitants in the central and northern parts of the county. Wheat is sown where the land is favourable to it, as along the shore north of Lancaster, in the Fylde, and in the south-west part of the county.

Potatoes were early cultivated in the fields in Lancashire, and they retain their celebrity when raised in the lighter soils, and when not over-manured. The land which is broken up from grass produces the best flavoured potatoes without any additional manure; but when they are raised to feed cattle the dung is not spared, and very great crops are obtained. Early potatoes are sometimes raised, with a crop of turnips after them the same year; then follow wheat or barley, and grass-seeds. If the turnips are drawn off the land, the next crop must be manured, or else the soil will be much impoverished. Sometimes two crops of early potatoes are raised in one year; the second is taken up in November, and immediately cut up into sets, which are preserved in chaff or sawdust, in which they shoot early in the ensuing year. They are then planted out, and secured from frost by throwing litter over the beds when they first come up. Another method is to cut the sets, and put them on a room floor, where a strong current of air can be introduced at pleasure; they are laid very thin, and covered with sawdust or chaff, about two inches deep. There they shoot, and the air being let in when there is no frost, the shoots get strong. When they are an inch and a half long, the covering is lightly removed to give access to the light. They remain growing till the time arrives for planting, when they are planted out carefully, and soon begin to throw out stems and leaves. They then bear slight frosts without much injury. The earliest potato is called the Superfine White Kidney. Several crops of this potato may be raised one after another in the same year by great attention to forwarding the sets and planting them out carefully; and where there is a demand for young potatoes the profit is very great.

Meadows and pastures are much more common in Lancashire than arable fields. Even the extent of grass which is kept for the purpose of bleaching linen on is very considerable, especially in the neighbourhood of Manchester, Bolton, and other manufacturing towns. While in other parts of England meadows and pastures are broken up and converted into arable fields, in Lancashire the reverse is the case, and many fertile arable fields have been laid down to permanent grass. There is a great inducement to do this, for the best meadow grasses and the white clover seem to find a peculiarly favourable soil in the best loams of Lancashire; and by simply marling the land white clover springs up naturally. The demand for hay has caused great attention to be paid to the making and securing of it, and extensive hay-barns which admit the air freely have been erected in many places. [Barn.]

In feeding cattle or cows for the dairy a good pasture will keep one head per acre during the summer, but there are many of which two or three acres are required to maintain a milch cow.

Sheep are not abundant in proportion to cows; and there is not that attention paid to the breed of this useful animal which it deserves; the breeds commonly met with are the black-faced and the Cheviot. The improved Leicester has gained a footing, and will not soon lose it.

The original breed of oxen in Lancashire was one of the best in England until it was surpassed by the Leicestershire, which is only the same blood improved by careful selection. The animals of this breed have a great aptitude to fatten, and some of the cows are good milkers; but the farmers and dairymen are so careless, that if a cow or an ox has a good appearance in the market, the pedigree is never inquired into. Milk is a very important article of food in a populous district, where it can be sold as it comes from the cow; and the profit of a dairy is never so great as where new milk can be thus disposed of. Where the population is thinner, or the distance from towns is too great to carry new milk for sale, butter and cheese must be made. A great quantity of both is produced in Lancashire, and of a very good quality. The cheese is similar to the Cheshire, and, when carefully made, cannot be distinguished from it. The cheese from some particular spots, as near Leigh, Newborough, &c., is thought to be superior to the Cheshire. There is no colouring whatever put into this cheese; but inferior kinds are frequently coloured to make them pass for Cheshire. The quantity of cheese made from one cow between April and November is about 360 lbs. Mr. Boys, in the 'Agricultural Survey,' has given an account of a cow of the Lancashire breed which gave 16 lbs. of butter, each of 18 ounces, or 18 lbs. avoirdupois in one week. She had had five calves, and was eight years old. The progeny of this cow, which was one of the Lancashire long-horned breed, kept up her reputation: but no trouble was taken to obtain a pure breed from her. In 1795, at the Roman Catholic College at Stonyhurst near Clithero, the cows were kept in stalls and fed with boiled food, as is the case in Flanders. Weeds, nettles, and docks were collected and boiled with more succulent vegetables. Thus, nearly half a century ago, an example was given of the

Flemish mode of feeding cows, without its having been followed in a single instance; and yet it is noticed with approbation. This proves how difficult it is to alter old customs in husbandry.

Many useful horses are bred in Lancashire, for which there is a great demand in the manufacturing towns. They are chiefly cart-horses of a hardy active sort; and, with a little attention, the rearing of them is profitable to the farmer. They are worked gently when two years old, and soon earn their keep; at five years old they bring a high price, if they have a good shape and work well. The rich pastures make them grow to a large size, and look sleek when brought to a fair. There is nothing peculiar in the breed of swine. A great deal of pork and bacon is imported from Ireland.

LEICESTERSHIRE AGRICULTURE. The climate of Leicestershire is mild and genial, without being so moist as in those counties which lie nearer the Atlantic. There are few high hills to intercept the clouds. The soil is loamy, without the extremes of stiff clay, loose sand, or chalk. It varies in fertility according to its texture, depth, and freedom from superfluous moisture. The most fertile soils are almost invariably kept in pasture, for which this county is pre-eminent; the poorer and thinner soils only, which are not so well adapted for grass land, being kept in arable cultivation. Out of above 500,000 acres of surface, fully one half is in permanent grass. The quantity of woods or wastes is very small.

There are many large landed proprietors who have family seats in this county, and they have in general some portion of their domains in hand. By employing intelligent bailiffs they greatly contribute to the improvement of husbandry. Grazing and breeding cattle and sheep is the chief object of the Leicestershire farmers, and they have succeeded admirably both with oxen and sheep. The success of Mr. Bakewell, of Dishley farm, and some others, has contributed greatly to excite a spirit of emulation in the breeders, and to make them attentive to keep up the good qualities of the breeds, and to prevent their degenerating by injudicious crosses. The arable land has however not been neglected; and the quantity of stock kept, for which artificial food must be provided in winter, has not only supplied abundant manure to recruit the land, but also made the cultivation of turnips, potatoes, cabbages, and green crops more general and extensive than in many other counties, which cannot fail to improve the crops of corn sown after these, and to keep the land in a productive state.

The plough in common use has two wheels fixed to the end of the beam, which is like that of a common swing-plough, the horses drawing the plough by the beam. This is better than the arrangement of carriage of a common wheel-plough, where the beam only rests upon it without being fixed. This plough, which is generally used in the midland counties, and is known by the name of the Rutland plough, when properly set requires no one to hold the stilts after it is once entered into the furrow, but will keep its depth and direction, provided the horses keep their proper course. Most of the improved modern instruments, such as scarifiers, spiked rollers, and drills, have been introduced, and are used in the larger farms, which are chiefly in the hands of the proprietors. In many parts of the county the occupations are small, not exceeding 100 acres, where the farmer holds the plough himself, and his family do most of the work of the farm. The course of crops of the grazier, breeder, or principal farmer is very commonly as follows:—On good friable loams, 1, a green crop to clean the land, turnips, rape, or cabbages; 2, barley, with clover and grass seeds; 3 and 4, clover mown and pastured; 5, oats or wheat. This is a very good rotation, if the clover be only sown every second course, or be mixed with a considerable proportion of rye grass, trefoil, and other grasses; for the clover will fail if it recur too often. On a good heavy loam the following has been observed: 1, beans drilled; 2, wheat; 3, green crops; 4, barley and seeds; 5 and 6, grass. This is an excellent rotation, the manure being put on for the beans and green crops.

The natural meadows along the banks of the rivers are considerable, and most of them of excellent quality. On the banks of the Soar, near Leicester, is a considerable tract of excellent meadow land, apparently formed by the deposition of the sediment of that river, which still inundates it occasionally, and keeps up the fertility. The upland meadows are very good also, but require to be manured occasionally. The produce in hay is from one and a half to two tons per acre.

There are considerable dairies in Leicestershire, especially on the borders of Derbyshire; and very good cheese is made there. The cheese known by the name of Stilton is chiefly made in Leicestershire, and has obtained its name from having been first noticed at an inn in Stilton. It is a very rich cheese, in which a great portion of cream is added to the milk in the making. It requires great nicety in the management, to bring it to a proper state of maturity, and keep a rich mild flavour in it. Every dairy-woman has her own secrets, which she does not readily communicate; and hence attempts to imitate Stilton cheese are seldom successful. That it can be made elsewhere is proved by that which goes by the name of Windsor Forest cheese, which is superior to most of the cheese which is sold as Stilton, and is eagerly purchased at two shillings the pound. [CHEESE.] In a good dairy a cow is reckoned to make, on an average, 4 cwt. of cheese in the year, and to require for her keep summer and winter 3 acres of land. Four cows will fatten a pig of 40 lbs. to 12 score, which is an increase of 50 lbs. for each cow, besides the cheese and the calf. This will altogether afford a rent of 30*s*. to 40*s*. per acre. An acre of good sheep pasture will keep, during the summer, two ewes and their lambs and two wethers, and, with a quarter of an acre of green crops, during the winter also. Thus 80 sheep may be bred and fatted upon 50 acres of land. This will likewise afford a rent of about 30*s*. per acre.

A great portion of the low pastures has been much improved by draining; some were drained by Elkington himself, and at considerable expense; but the increased value of the land amply repaid the outlay. In consequence of the demand for streams to turn mills, wherever there is any fall, the irrigation of meadows is not carried on to the extent it might be. Mr. Bakewell and several other enterprising farmers have, however, irrigated extensively, and with great advantage.

The principal breed of cattle in Leicestershire is the improved long-horn, which owes its high character to the intelligence, activity, and perseverance of Mr. Bakewell of Dishley farm near Loughborough. [CATTLE.]

The sheep, for which this county is also renowned, equally owe their superiority to the same individual. They are large, with very long wool, and fatten very readily at an early age. All these qualities render them valuable in good pastures, which they require. [SHEEP.]

In a county where the amusement of fox-hunting is followed with great eagerness, it may be expected that many good horses are bred, and the rich pasture favours the rearing of this useful and noble animal. Many well-bred horses are annually sold by the breeders, and realise great prices; but the risk in breeding high-bred horses is very great, and unless carried on extensively, is seldom very profitable. Good useful cart-horses are a safer speculation; they are easily reared, come soon to market, and are less liable to accidents and diseases.

Hogs have been improved in Leicestershire, as well as other animals. This has been done chiefly by crossing with foreign breeds, such as the black Neapolitan and the Chinese. The Dishley swine are small boned, compact, and get extremely fat. There are larger breeds, but the middle-sized are, on the whole, the most profitable.

LINCOLNSHIRE AGRICULTURE.—The agriculture of Lincolnshire is interesting on many accounts. The soil varies greatly in different districts. In some places it is as rich and productive as the greediest farmer could desire, and in others so poor as to weary the patience and industry of the most persevering. The grazing land in this county cannot be surpassed in its capabilities for fattening cattle; and some of the drained fens and warp lands along the rivers possess a high degree of fertility when cultivated.

From these circumstances it follows that every variety of cultivation which this island presents may be observed in this county. There are still some lands which are under the old course of two crops and a fallow, while others are cultivated with all the care which an improved system of husbandry recommends.

To give a general idea of the various kinds of soil, we will follow the division given by A. Young in his Report of this county; premising, however, that it cannot be considered as entirely correct, but only an approximation to the truth.

	Acres.
He reckons of fen lands .	776,960
Of loamy and sandy heaths, now mostly cultivated	118,400
Of wolds, chiefly chalk .	234,880
Of various loams and sands of moderate quality	718,080
Making a total of .	1,848,320

Upon the whole the majority of the lands in Lincolnshire may be said to possess a soil of more than medium fertility, compared with the average of Great Britain, and the produce of the county, both in grain and cattle, is very considerable.

The temperature of Lincolnshire is nearly the same as that of the centre of England. The flatness of the surface allows the winds to blow uninterruptedly over it, and of these the western are the most violent. Near the coast the sea tempers the cold easterly winds in winter, and the snow seldom lies long.

The climate in the lower parts, where, in spite of extensive drainings, much marshy ground still remains, is not very healthy, and intermittent fevers are prevalent; but they are becoming much less frequent since the draining and improvement of the soil. The water in the lower parts is bad and brackish, being procured only from wells and ponds; there is no such thing as a spring of pure water in the fens. The lands which have been reclaimed from the sea by banking and draining are mostly laid in large farms, which require a considerable capital. In other parts of the county there are many small properties, cultivated by the owners, and kept with great neatness. There were formerly many more of these than there are now. Lincolnshire exhibits great neatness in the care with which the land is weeded and manured, especially the light sands. The introduction of bones for manure has made many poor light sands in Lincolnshire vie with the best in production, and nowhere have ground bones been used so long and so abundantly. The turnips, which are raised by means of this manure on the poorest sands, being fed off with sheep, lay the foundation of a productive course without any other manure.

Among the different manures which are used for the arable land in Lincolnshire, we must not pass over that of fish, especially that small fish which abounds in shallow waters, and is named the stickleback. It is very soon putrid, and greatly assists the natural juices of the earth in producing vegetation.

On the richest fen lands the most profitable rotation consists of the following crops:—1, Cole, fed off with sheep; 2, oats; 3, beans; 4, wheat; 5, clover; 6, wheat. If wheat were sown immediately after the cole, it would be rank, and probably lodged. The oats and beans reduce it to a proper state, by exhausting a portion of the manure and preparing the soil better for wheat. The oats are always fine and abundant, seldom less than 8 quarters per acre, and often 10 and even 12 quarters.

In some heavy soils the Essex rotation is adopted:—1, fallow; 2, barley; 3, beans; 4, wheat; and this, alternated with the other, answers well on rich lands. A fallow once in ten years is almost indispensable, to keep the land free from root-weeds. The clover also recurs less often, and is consequently less apt to fail than when it is sown every sixth year on the same land. Those who have been induced by some eminent agricultural writers, such as Arthur Young, and others, to attempt to cultivate heavy and wet soils without an occasional fallow, have soon been obliged to return to this effective mode of cleaning land: the hoeing of beans or other green crops can never be executed so perfectly as to keep the land entirely free from those destructive weeds which have perennial roots. For the poor sands there is no system so advantageous as that of raising turnips, and feeding sheep with them on the land where they grew. The tread and urine of the sheep give consistency to the loose sand, and, for a time, impart to it the properties of a good loam, so that it will retain water sufficiently to supply the roots of the growing corn. If marl can be put on the surface at the same time, the nature of the soil will be greatly improved; and that which would only bear a crop of oats, will now become capable of giving a good return of wheat. Manure alone cannot effect this; it would only cause the wheat to run to straw and lodge, and give no grain. To manure poor lands highly, without first consolidating them, is absolute loss of both dung and labour.

From the returns of forty different farms, A. Young has given the average produce in Lincolnshire as follows:—

Wheat—seed, 3 bushels; average crop, 3½ quarters. Barley—seed, 3¾ bushels; average crop, 4½ quarters. Oats—seed, 6 bushels; average crop, 6½ quarters. Beans—seed, 3¾ bushels; average crop, 3¾ quarters.

It is probable that the general adoption of the drill in sowing, and the improvement of the cultivation since the report of A. Young, have increased the proportion of the crop compared with the seed about one-eighth.

The crops usually raised on the arable land are mostly the same as in other counties on similar soils. There is some woad cultivated in the neighbourhood of Boston on rich warp-land; some sainfoin grown on the chalky soils, and lucern on the richer; but not to the extent to which this useful plant ought to be cultivated as green food for horses and cattle. Cabbages and carrots are cultivated to a considerable extent; the former on the heavy clays, and the latter on the light and deep sands.

The grass-lands of Lincolnshire and of the neighbouring county of Leicester are some of the best feeding lands in the kingdom. The average number of beasts of a moderate size, about 70 or 80 stone of 14 lb., which can be kept on an acre, taken from twenty-six places, is stated by A. Young to be as follows:—sheep in summer, per acre, 3¾; sheep in winter, per acre, 2; acres to feed a bullock in summer with the sheep, 1¾. So that 1¾ acres of grass-land will feed—in summer, 1 bullock and about 6½ sheep; and in winter, 3¼ sheep, which is a high average: some of these lands will feed a bullock and 6 sheep per acre all the summer.

Some of the finest pastures are fed off by horses which are fatted for the markets; but horses soon deteriorate the grass, while sheep improve it.

Graziers are not fond of mowing grass for hay. It renders the pasture coarse, and the hay is not of so rich a quality as might be expected, owing, probably, to a want of care in making it. Grass-land is occasionally broken up to grow woad or flax on it. When this is done very judiciously, it may be laid down with grass seeds and soon be good pasture again: but, in general, it is a long time before the newly-sown herbage is so fattening as the old grass. When grass-land is broken up it gives such rich crops, that the temptation to overcrop it is too strong to be resisted; and once exhausted to a certain degree, it cannot be restored to its richness for a long time. When arable land is laid down to permanent grass in a rich, clean, and unexhausted state, the success is invariable; but it is often done without attention, and a failure is the consequence.

One of the most effectual improvements on land, by the side of some rivers in which the tide flows rapidly, is that of warping; or, in other words, retaining the water on the land so long as to let it deposit a layer of sand and mud. Thus a new soil is created over an old one; and this deposited soil is always very fertile. Such is the benefit produced by warping, that expensive works have been raised for the purpose, and extensive tracts of poor land have been covered in a short time with a new soil of the finest quality, as the crops raised upon it will clearly show.

The warping is effected by letting in the water of the rivers, which have a muddy current, by artificial channels and sluices, and retaining it there till low water. The river Humber carries off, in its course over various soils, all the finer particles which are too light to be immediately deposited. These consist of every kind of earth and portions of vegetable and animal matter. The tides, which are continually changing the direction of the current, keep this earth in suspension by the agitation which is produced; and when the water charged with earth is let in on the low grounds by the side of the river by means of canals and sluices, the earth is soon deposited and forms a coat of mud of a highly fertile nature. Such is the quantity of earth contained in the water, that a layer one-tenth of an inch in thickness is often deposited between one tide and the next. Thus in a very short time a new soil is formed of any depth which may be desired, provided the land lies below the level of the river at high tides.

Besides creating a soil, the warping fills up all inequalities, and a perfectly level surface is produced. Warp land possesses a natural power of production, which cultivation and manuring cannot imitate. The basis of the soil is fine clay and sand, the latter minutely divided and intimately mixed with the former, with a considerable portion of fine calcareous earth. Very little vegetable matter can be extracted by analysis, but there is no doubt a very considerable portion of it in an insoluble state, probably combined with lime or argilla. Sufficient experiments have not yet been made to show this combination, as likewise the galvanic effects of the intimate mixture of the different earths. It is to be hoped that the attention of agricultural chemists will be turned to this subject. Considerable light may thus be thrown on the causes of fertility in soils.

The atmospheric air seems to act powerfully on the newly deposited warp: for before a fresh layer is deposited, which is within twelve hours, such an alteration has already taken place on the surface, that the new deposit does not unite in one mass with the last, but a regular stratification can be observed, which shows the quantity deposited in each tide. The new warp also requires to be stirred and exposed to the air for some time before it acquires its great fertility. It is therefore probable that the insoluble vegetable earth requires to be oxygenated and rendered soluble. The richest crops of beans, wheat, oats, and rape are raised without manure on the warp lands. It is not so well adapted for barley or turnips on account of its slimy nature.

It has added much to the produce of Lincolnshire, that the crops raised on the warp lands have enabled the farmer to employ all the manure made by the abundance of straw which these lands produce to improve the lands that lie above the reach of the waters. As long as the level of the warp lands allows a fresh addition of warp, this system is highly advantageous; but as soon as the surface rises to high-water mark, this system must cease, or the warp lands will be exhausted in time, like the Dutch and Flemish *polders*, and require manure like other lands. The best mode of treating warp lands which are too high to admit of being warped over again is to lay them down to grass in a state of great fertility. The pasture upon them will soon equal the best old grass, carrying a bullock per acre, besides several sheep during the whole of the summer.

In a county which contains so rich pastures it is of great importance that the breed of cattle and sheep be of the most profitable kind; accordingly we find that no county possesses finer breeds of horses, oxen, and sheep. The Lincolnshire horses are celebrated for their size and power. Horncastle fair is the great resort of all the London dealers, who purchase hunters and carriage-horses at very high prices. The horses which are bred in the fens are apt to have rather too flat and broad feet, from the softness of the pastures there. This is a great defect when they are intended for speed on hard roads; but for farm purposes they answer as well as those bred on drier soils. The best hunters are bred on the higher and drier lands; but they are generally turned out for a time in the richer pastures to give them flesh before they are sold.

The oxen which are preferred for grazing are the short-horns, and some crosses of long-horns. Mr. Collins's Durham breed has been introduced and kept up with considerable success. Some rich proprietors and farmers are very careful in maintaining the reputation of their stock; and fine bulls are reared without regard to expense, which is well repaid by the superiority of their produce. The most judicious graziers are of opinion that middle-sized oxen are more profitable for grazing than the larger: an ox of about 80 stones of 14 lbs. is thought to fatten more rapidly in proportion than either larger or smaller, provided the breed be good.

There are not many dairies in Lincolnshire: breeding and fatting are considered more profitable and less troublesome. There is, however, some excellent cheese made of the Stilton kind. A. Young mentions Mr. Grundy, of Heath Hall, near Grantham, as an eminent cheese-maker. A descendant of his is now residing at Old Windsor, in Berkshire, where he makes the famous Forest cheese, which still goes by the name of Grundy cheese, and is the best cheese of the Stilton kind made in England. He was brought from Lincolnshire by George IV., and established in a royal dairy in Windsor Forest. The sheep which are bred in this county are principally of the long-woolled, commonly called Leicesters. But the two counties differ only in the great proportion of fen lands to be found in Lincolnshire. The rich upland pastures are similar in both counties. The old Lincoln sheep are larger than the improved Leicester, and carry a heavier fleece; they are also hardier; the latter, however, are generally preferred, from their greater propensity to fatten. A cross has been produced which partakes of the qualities of both breeds, and is preferred by some for the fens.

There is nothing particular in the breed of pigs, except that it has been much improved of late years by crossing with improved breeds.

LIVE STOCK. The animals necessary for the stocking and cultivation of a farm, and those which are kept on it for profit, or for the sake of their dung, are called the live stock of the farm, in contradistinction to the dead stock, which consists of the implements of husbandry and the produce stored up for use.

The live stock on a farm must vary according to circumstances. The number of horses or oxen kept for the cultivation of the land and other farming operations should be exactly proportioned to the work to be done. If they are too few, none of the operations will be performed in their proper time, and the crops will suffer in consequence. If there are too many, the surplus beyond what is strictly required is maintained out of the profits of the farm. To have the exact number of animals which will give the greatest profit is one of the most important problems which a farmer has to solve: what may be very profitable in one case may be the reverse in another; and, as a general maxim, it may be laid down, that the fewer mouths he has to feed, unless they produce an evident profit, the less loss he is likely to incur. But this rule admits of many exceptions. It is of great importance, in taking a farm, to calculate the extent of the arable land, so that it can be properly cultivated by a certain number of pairs of horses or oxen. It is an old measure of land to divide it into so many ploughs, that is, so many portions which can be tilled with one plough each. When there are several of these, it is useful to have an odd horse over the usual number required for two or three ploughs, to relieve the others occasionally. The work is thus done more regularly and with greater ease. Where there are two ploughs with two horses each, a fifth horse should be kept, and so in proportion for a greater number. The odd horse will always be found extremely useful, if not indispensable, and the expense of his keep will be amply repaid by the regularity and ease with which the whole work of the farm will be done, and the relief which occasional rest will give to the other horses.

The other part of the live stock kept on a farm must depend on various circumstances. Where there is good grazing land, the profit on the improvement of the live stock, or their produce, is evident and easily ascertained. But where animals are kept upon artificial food or fatted in stalls, it is often a difficult question to answer, whether there is a profit on their keep or not. In most cases the manure which their dung and litter afford is the chief object for which they are kept. If manure could be obtained in sufficient quantities to recruit the land, at a reasonable price, it might often be more advantageous to sell off all the hay and straw of a farm, and to keep only the cattle necessary to till the ground or supply the farmer's family. But this can only be the case in the immediate neighbourhood of large towns. In the country at a greater distance no manure can be purchased; it must consequently be produced on the farm; and for this purpose live stock must be kept, even at a loss. The management and feeding of live stock is therefore an important part of husbandry. The object of the farmer is principally to obtain manure for his land, and if he can do this, and at the same time gain something on the stock by which it is obtained, he greatly increases his profits. Hence much more skill has been displayed in the selection of profitable stock than in the improvement of tillage. Some men have made great profits by improving the breed of cattle and sheep, by selecting the animals which will fatten most readily, and by feeding them economically. It requires much experience and nice calculations to ascertain what stock is most profitable on different kinds of land and in various situations. Unless very minute accounts be kept, the result can never be exactly known. It is not always the beast which brings most money in the market that has been most profitable; and many an animal which has been praised and admired has caused a heavy loss to the feeder. Unless a man breeds the animals which are to be fatted, he must frequently buy and sell; and an accurate knowledge of the qualities of live stock and their value, both lean and fat, is indispensable. However honest may be the salesman he may employ, he cannot expect him to feel the same interest in a purchase or sale, for which he is paid his commission, as the person whose profit or loss depends on a judicious selection and a good bargain. Every farmer therefore should endeavour to acquire a thorough knowledge of stock, and carefully attend all markets within his reach to watch the fluctuation in the prices. It will generally be found that the principal profit in feeding stock is the manure, and to this the greatest attention should be directed. A little management will often greatly increase both the quantity and quality of this indispensable substance, and make all the difference between a loss and a profit in the keeping of stock. [Manure.]

LOAM, a soil compounded of various earths, of which the chief are silicious sand, clay, and carbonate of lime, or chalk. The other substances which are occasionally found in loams, such as iron, magnesia, and various salts, are seldom in such proportions as materially to alter their nature. Decayed vegetable and animal matter, in the form of humus, is often found in loams in considerable quantities, and the soil is fertile in proportion.

According as the loams are composed, so they vary in quality. Those which consist of a great portion of loose sand, with little humus, and with an impregnation of iron, are very unproductive; and those which contain too much clay, and are on an impervious subsoil, are very difficult to cultivate. But between these extremes there are soils which cannot be surpassed in fertility as wheat-land. What renders loams so much more fertile than either clays or sands is, that the pure earths are in themselves almost entirely barren: sand lets the moisture run through it and evaporate rapidly; clay retains it, but locks it up in its own substance, and does not allow the tender young roots of plants to push through it; chalk has the same mechanical quality, besides containing very little organic and soluble matter, from which plants derive their chief increase. Sand and clay alone, without a considerable portion of humus, will not make a rich soil; but when a portion of calcareous earth is joined to both, the humus is more readily rendered soluble, and the clay and sand are prevented from forming a mortar, which would harden too readily, and prevent the influence of the air from reaching the roots. Good loams allow of that circulation of moisture which acts so prominent a part in the process of vegetation. It is almost universally admitted that the most fertile soils always contain a proportion of calcareous matter; and by adding chalk to those soils in which it does not abound, whether sandy or argillaceous, a manifest improvement is always produced.

It has been asserted that in the climate of France, in the neighbourhood of Paris, the best soil for the growth of wheat is composed of equal portions of fine sand, clay, and chalk. Upon what grounds this is assumed, does not appear very clear. The greater the natural moisture of any climate, the greater proportion of sand is required to make a fertile loam; and the greater the proportion of humus, the less sand will be required to temper the clay. The analysis of soils known to be extremely fertile gives a very great difference in the proportions of the different earths.

In the climate of England the soil which is generally preferred for cultivation is a loam, rather light than heavy; at least half of which is silicious sand, one-third clay, and the rest chalk. Such a soil is called a good loam; it is land which will produce almost everything which is usually cultivated on sands or clays: it is not too stiff for carrots and turnips, and not too loose for wheat and beans. It is of most easy cultivation at all times of the year, provided the subsoil be sound, and not too retentive of water. It requires only to be occasionally recruited with manure, to restore to it the humus which vegetation has consumed, and to be kept free from the weeds which naturally spring up in all fertile soils. All attempts to improve the nature of a soil should have for their object the bringing it to a state of loam, by the addition of those substances which are deficient. If there is too much clay, chalk and sand may be added, or a portion of the clay may be calcined by burning, in order to destroy its attraction for water, and thus act the part of sand in forming the loam. Limestone or calcareous sand and gravel are still more efficacious for this purpose: they not only correct too great porosity, or too great tenacity, but also act chemically on the organic matter in the soil, rendering the humus soluble, and fit to be taken up by the roots of plants. If there is too much sand, marl composed of clay and chalk is the remedy. Good loams require much less tillage than stiffer soils, and will bear more stirring to clean them than sands. Hence they are cultivated more economically, and more easily kept free from useless weeds; while the produce is more certain and abundant. They can be impregnated to a higher degree with enriching manures, without danger of root-fallen crops, or of too great an abundance of straw at the expense of the grain. For artificial meadows they are eminently proper: all the grasses grow well in good loams, when they are on a dry or well-drained subsoil, which is an indispensable condition in all good land. Sheep and cattle can be depastured on them during the whole year, except when there is snow on the ground. If there should be means of irrigation, no soil is better suited to it than a light loam on a bed of gravel; or even if the subsoil is clay, provided sufficient under-draining prevent the water from stagnating between the soil and subsoil, which, as practical men very properly express it, would poison any land.

A loamy soil requires less dung to keep it in heart than either clay or sand; for while it is favourable to the process by which organic matter buried deep in the soil is converted into insoluble humus, it also permits that part of it which is nearer to the surface to attract oxygen from the air, and thus it is converted into a soluble extract, which is to the roots of plants what the milk of animals is to their young—a ready-prepared food easily converted into vegetable juices.

The analysis and classification of soils is of the greatest importance to all those who take farms; for the rent of land is very seldom proportioned to its intrinsic value: one farm may be worth double the rent of another, where the apparent difference in the soil is very trifling. Those who have had long experience of the expense of cultivation, and the average produce of certain lands, can nearly guess what rent it may be safe to offer; but a stranger has no criterion to judge by. Hence it is notorious that a stranger coming to take a farm from a distant district is almost invariably deceived. Why should not the value of a soil be ascertained as readily as that of any article of commerce? If there were certain points of comparison, it would be so: but in this the theory of agriculture is wofully deficient. A man guesses at the qualities of land by the colour, the feeling, and other uncertain signs; it seldom or never occurs to a farmer to examine the component parts of a soil, by merely diffusing a portion in water, and testing the deposits—much less to compound artificial soils, and compare them with those found in the fields. Yet every gardener can prepare soils suited to different plants and make loams of all degrees of richness or consistence. In all these it will be found that sand, clay, chalk, and decayed vegetable substances, in various proportions, are the chief ingredients. If therefore these are found in a natural loam, we may safely conclude that it will be equally productive, and the deficiency of any one ingredient may be supplied artificially. This would be going rationally and scientifically to work; and the result would be a more certain and satisfactory practice of husbandry.

It might be an interesting and highly useful inquiry to ascertain the effect of the contact of various kinds of earth, moistened with water, in exciting galvanic action, which no doubt greatly influences the chemical affinities of the elements from which the plants derive their increase. It is a subject which has scarcely ever been noticed, and we would strongly recommend scientific experiments in this branch of vegetable physiology.

LUCERN (*Medicago sativa*), a plant of the Linnæan class Diadelphia and order Decandria, with a papilionaceous flower, and of the natural family of the Leguminosæ. There are many species of the Medicago, of which one is supereminent as an artificial grass in temperate climates, and a most valuable plant for feeding cattle. It was in high repute among the ancients. The authors *De Re Rustica* speak of it with enthusiasm, and all over the continent of Europe, wherever husbandry has made any progress, it is in high reputation. Lucern is a plant which will not bear extreme frost nor superabundant moisture, and its cultivation is therefore restricted to mild climates and dry soils; but, where it thrives, its growth is so rapid and luxuriant, that no other known plant can be compared to it. In good deep loams lucern is the most profitable of all green crops; when properly managed, the quantity of cattle which can be kept in good condition on an acre of lucern, during the whole season, exceeds belief. It is no sooner mown than it pushes out fresh shoots, and wonderful as the growth of clover sometimes is in a field which has been lately mown, that of lucern is far more rapid. Where a few tufts of lucern happen to be, they will rise a foot above the surface, while the grass and clover, which were mown at the same time, are only a very few inches high.

Lucern, sown in a soil suited to it, will last for many years, shooting its roots downwards for nourishment till they are altogether out of the reach of drought. In the driest and most sultry weather, when every blade of grass droops for want of moisture, lucern holds up its stem, fresh and green as in a genial spring. The only enemies of this plant are a wet subsoil and a foul surface. The first is often incurable; the latter can be avoided by good cultivation.

It is useless to sow lucern on very poor sands or gravel, or on wet clays. The best and deepest loam must be chosen, rather light than heavy, but with a good portion of vegetable earth or humus equally dispersed through it. If the ground has been trenched, so much the better; and if the surface is covered with some inferior earth from the subsoil, it will be no detriment to the crop, for it will prevent grass and weeds from springing up, and save much weeding. The lucern will soon strike down below it. It is not a bad practice to cover the lucern-field with a coat of coal-ashes or poor sand, merely to keep down the weeds, where this can easily be done.

The soil in which it is intended to sow lucern-seed should be well prepared. It should be highly manured for the two or three preceding crops, and deeply ploughed, if not trenched. It should be perfectly clean, and for this purpose two successive crops of turnips are most effectual. The turnips should be fed off with sheep. In the month of March, the land having been ploughed flat and well harrowed, a very small quantity of barley, not above a bushel to the acre, may be sown, or rather drilled on the ground, and at the same time from 30 to 40 lbs. of lucern-seed sown broad-cast, and both harrowed in and lightly rolled. If the land will not bear to be laid flat without water-furrows, it will be useless to sow lucern in it.

As the crop comes up it must be carefully weeded: no expense must be spared to do this effectually, for success depends upon it. When the barley is reaped, the stubble, which will probably be strong, should be pulled up by the hand-hoe, or by harrowing, if the plants of lucern be strong, and, at all events, the ground must be cleared of weeds. It must not be fed off with sheep; they would bite too near the crown. Lucern should always be cut as soon as the flower is formed. If it is kept clear of weeds the first year, there will be little difficulty with it afterwards, when the roots have become strong. The second year the lucern will be fit to cut very early, and in a favourable season it may be cut four or five times. After each cutting it is useful to draw heavy harrows over the land, or an instrument made on purpose resembling harrows, the teeth of which are flat, and cutting the soil like small coulters. It will not injure the plants, even if it divide the crown of the root, but it will destroy grass and weeds. Liquid manure, which consists of the urine of cattle and drainings of dunghills, is often spread over the lucern immediately after it has been mown, and much invigorates the next growth; but if the land is rich to a good depth, this is scarcely necessary. The lucern will grow and thrive from seven to twelve years, when it will begin to wear out, and, in spite of weeding, the grass will get the upper hand of it. It should then be ploughed up, all the roots carefully collected and laid in a heap with dung and lime to rot, and a course of regular tillage should succeed. The same land should not be sown with lucern again in less than ten or twelve years, after a regular course of cropping and manuring.

Cattle fed upon lucern thrive better than on any other green food. Horses, in particular, can work hard upon it without any corn, provided it be slow work. Cows give plenty of good milk when fed with it. In spring it is apt to purge cattle, which, with a little attention, is conducive to their health. If it is given to them in too great quantities, or moist with dew, they run the risk of being hoven. These inconveniences are avoided by giving it sparingly at first, and always keeping it twenty-four hours after it is cut, during which time it undergoes an incipient fermentation, and the juice is partially evaporated: instead of being less nutritive in this state, it is rather more so.

An acre of good lucern will keep four or five horses from May to October, when cut just as the flower opens. If it should get too forward, and there be more than the horses can consume, it should be made into hay; but this is not the most profitable way of using it, and the plant, being very succulent, takes a long time in drying. The rain also is very injurious to it in a half-dry state; for the stem is readily soaked with moisture, which is slow in evaporating. The produce in hay, when well made, is very considerable, being often double the weight of a good crop of clover hay.

Many authors recommend drilling the seed of lucern in wide rows, and hoeing the intervals after each cutting. This is the best way with a small patch in a garden, and when only a little is cut every day; but in a field of some extent, the lucern, when once well established and preserved free from weeds by hand-weeding the first year, will keep all weeds down afterwards, and the heavy harrows with sharp tines, used immediately after mowing, will pull up all the grass which may spring up. No farmer ought to neglect having a few acres in lucern on his best land.

MADDER (*Rubia tinctorum sativa*, Linnæus), a plant which is cultivated in particular districts for the roots, which produce a fine red dye. It was formerly more extensively cultivated in England than it is now, when it can be imported at a less expense than it can be raised. It requires a very rich and deep soil, and much labour and attention, besides occupying the ground for three years before it comes to perfection.

Any soil which is deep and dry, and in which there is a good proportion of humus, will suit this plant. A rich loam, inclining to a sand, in which the roots can spread and swell, while they find sufficient nourishment, is preferable to the stiffer soils. If it has lain for a considerable time in grass before it is ploughed up, it will be all the better.

The preparatory tillage of the land must be such as to pulverise the soil to a great depth, and so mix the manure, which must be abundant, with every part, that, wherever the roots spread, they may find sufficient nourishment. The land is usually laid in beds, with deep intervals dug out with the spade, somewhat like asparagus beds. The width of these beds differs according to the natural moisture of the climate; in Belgium they are only three feet wide; and that width seems the best for a moist climate like that of England, except upon very light soils, where a greater width may be more advantageous. Trenching with the spade is generally preferred to ploughing, and is most economical in the end; for, however well and deep the land may be ploughed, it must be forked or dug over again several times before the plants are put in.

The manure used for madder must be well rotten and mixed with earth in a compost a considerable time before it is used. Good stable-dung which has heated to a certain degree, and been turned over two or three times before it is mixed with earth, is the best. This earth should be sods taken from water-furrows in meadows and laid in a heap for some time. The dung should be put in layers with this earth, and if the whole can be well watered with urine or the drainings of the yard, and then mixed up by the spade, the compost will be much superior to fresh dung alone. This should be ploughed or dug in before winter. In spring another tillage may be given to destroy all weeds, and make the soil uniform to the depth of two feet at least. The land, having been harrowed flat, may now be laid into narrow beds by digging out the intervals with the spade; the surface being raked or harrowed smooth, the planting may begin.

The plants are raised in a seed-bed, or they are shoots and suckers from old plants. The first are a twelvemonth old from the sowing. The seed should be fresh; for if old seed is sown, it may not rise the first year. When a good variety of madder has been in cultivation, the shoots are preferred to seedlings; but when there is any appearance of the plants degenerating, a fresh sowing is had recourse to.

The suckers or shoots are taken off from the crown of old plants, when they have thrown out fibrous roots. They will then readily grow if transplanted. In southern climates this is done in autumn or winter, that they may not be scorched by the summer's heat. In northern climates June or July is the proper season, as there is never a deficiency of rain at that time. They may be also planted in February or March, if the ground is ready and dry: a showery time is advantageous. The plants are put in by means of a dibble, or rather a narrow trowel, which opens the soil, and then lets the earth fall upon the roots; a slight pressure sets them firmly in the ground. On a three-foot bed there are only two rows about 16 inches apart, and each 10 inches from the side. They are set by a line, from four to six inches from plant to plant in the rows. A watering with diluted urine, after sunset, greatly assists their taking root.

In some places the madder plants are put in with the plough. A deep furrow is drawn, and the plants are placed against the furrow-slice turned up; the return of the plough covers them, and makes a fresh bed for the next row. This may do on very rich, dry, light loams, but would not be advisable in heavier and moister soils. At every eighth or tenth furrow a water-furrow should be ploughed out and deepened with the spade: with these precautions the plants may thrive, and a great saving may be made in the labour when a considerable amount of madder is planted.

When the madder plants begin to grow, they must be well weeded and earthed up with the hoe. Liquid manure should be poured into the intervals, and the earth impregnated with it thrown around the plants.

The same attention to weeding and earthing up must be continued till the roots are fit to be taken up, which is in the third year.

The stems and leaves of madder are often cut as fodder for cattle, which are very fond of them: it is said that the colouring matter is so penetrating, that the bones of cattle fed on madder for a considerable time have been found tinged of a red colour. This practice however is not to be recommended, as it must injure the growth of the root, which is the valuable part. When the roots are taken up it is best done by means of a fork, so as not to break or cut them. The earth is loosened all around, and the roots laid bare. They are carefully taken out of the ground without breaking them, and laid on the surface to dry partially and become tough, after which they may be gathered into heaps under a shed, or protected from the weather by straw, if it be rainy. They are afterwards dried in a kiln, and are then fit to be sold to the dyers. If the quality is good, the root on being broken has a bright red colour verging towards purple. A yellow hue indicates inferiority. The produce of an acre of madder is from 10 to 20 cwt. If the rent and expenses of three years are taken into consideration, and the manure and labour required, it will be readily seen that unless the price be 4*l.* per cwt. it will not pay so well as a common crop of potatoes, carrots, or parsnips, which will not require so good a soil nor so much manure. This is a sufficient reason for the decrease of the cultivation of madder in England. In some particular instances great profits have been realised by madder; but the demand is limited, and the price fluctuates so much, that it is not a crop to be recommended, except in peculiar situations and circumstances.

MAIZE, or *Indian Corn*, is a plant commonly cultivated in the warmer parts of the world, where it answers a purpose similar to that of wheat in more northern countries. It is the *Zea Mays* of botanists, a monœcious grass, of vigorous growth, with stems not more than two feet high in some varieties, and reaching the height of eight or even ten feet in others. The leaves are broad, and hang down from large rough sheaths which surround the stem. The male flowers grow in loose, terminal, compound racemes, standing clear of the leaves; the females are arranged in numerous rows on a spike, which is wrapped round by several folds of sheathing bracts, which press upon the grains and give them the flattened figure they eventually acquire when ripe. Each grain has a long thread-like style, which projects beyond the enveloping sheaths; and as there are some hundreds of them upon each spike, the whole form a long tassel, which looks as if made of silk. The ripe grains are regularly arrayed one over the other in rows, are compressed at the sides, flattened at the apex, and of various colours. Their most common colour is pale yellow; some are white, some party-coloured, and there are varieties with blood-red and even purple grains. A plant generally bears two full ears, the grains of which vary greatly in number: some of the largest ears in America contain at least 800 grains.

This plant in its wild state is met with in Paraguay, according to Auguste de St. Hilaire. It was also found on the continent of North America by the Europeans on their arrival there. A second species, called *Curagua* by Molina, is said to occur in Chili; but little is known of it further than that the leaves are serrated, and all the parts much smaller than usual,

It seems that there is a particular line on the continent of Europe north of which the maize does not thrive. To the south of this line, which passes through Nancy, formerly the capital of Lorraine, in France, it has in a great measure superseded wheat and rye as the common produce of the land. The bread made from maize is not so palatable as wheat or rye bread; but by mixing it in certain proportions with wheat it makes a very pleasant food. In the United States of North America, Indian corn forms almost the only bread eaten by many of the people; and in the slave-states it is the only bread that the negroes eat. It is not, however, in the shape of baked bread that maize is most generally used in Europe, but in boiled messes and soups, as peas are with us; it is not only the ripe grain which is eaten, but the ear in every state, from that of a green vegetable to an unripe corn. It is boiled, stewed, and baked: it is a substitute for cabbage or green peas in its early stage; and is used in some way or other to its complete maturity. Nothing can be better than ripe maize to fatten hogs or poultry with; and the young stem cut down quite green gives one of the best and most abundant varieties of green food for cattle.

A plant which gives such a return cannot be expected to ripen its grains in poor land, or without attentive cultivation. The land must be naturally fertile or made so by art; it must be well prepared to receive the seed, and sufficient manure must be given to recruit it. A light, moist, and warm soil suits this plant best. It thrives well on land broken up from grass, as is the case with most plants. As it is always sown in rows, and the plants thinned to a considerable distance, the intervals may easily be ploughed, or stirred with the horse-hoe, by which means the weeds are kept down, and the earth fertilized by exposure to the air. The seed should be taken from the largest and best formed ears; those at the end should be rejected as less perfect. They should not be taken off until they are wanted for sowing, and then steeped in water to soften them. If the seed were steeped in brine and dried with quicklime, as is usually done with wheat, it might probably be advantageous, as this grain is subject to smut and brand, as well as wheat; but this is not often done. The time for sowing maize in the south of France is the month of April; farther north it is sown later for fear of frost, which would entirely destroy the plant on its first appearance above ground: this is one of the reasons why it could not safely be sown in England before the middle or end of May, and it could scarcely be expected to ripen its seeds before the winter's frost set in.

The distance between the rows of maize varies from two to four feet. In good ground the latter distance has produced the heaviest crop. The seed is sometimes sown in the furrow after the plough, and sometimes put in with a dibble. The latter seems the best way, and, as the rows are wide and the seeds need not be put in nearer than a foot apart in the rows, an acre will be soon dibbled by hand. Two or three inches deep is sufficient to make the seed germinate readily. In warm moist climates the plant is very soon above ground. In fine weather, and when the seed has been steeped, it will be above ground in five or six days. When the plants are three or four inches out of the ground, and no frost is feared, they are thinned out to two feet apart, and in very rich soils three feet is better. In this case three or four ears may be expected to ripen on each stalk. In thin soils on a retentive subsoil the earth is raised in ridges, or, which is better, in mounds, by crossing the ridges with the plough, and three or four seeds are put into each hillock, which are two or three feet apart. As the plants rise, only one or at most two are left in each hillock, and the earth is carefully moulded up to the stems; thus a deep dry bed is provided for the plant, and there is sufficient moisture from the impervious subsoil. This method might perhaps be adopted with advantage in England, in experiments on maize, where the situation admits of its cultivation. Maize, however sown, must be repeatedly hoed. At the first hoeing the plants which are too close are pulled up, and where there is a deficiency they are planted in: at least, this is the practice in Europe; but in America the general practice is to plant fresh seeds in the vacant places. When the plants are a foot high, there is a second hoeing, the weeds are then cut up, and some earth is drawn towards the plants, and raised around the stems. The reason of this is, that there are several joints very near each other at the bottom of the stem, and from each of these fibres strike out into the soil which is brought into contact with it, and form additional roots to the plant, as they do from the crown of the roots of wheat. When the flowers are ready to expand, a third hoeing is given, to kill weeds and open the surface of the soil slightly. The earth which is raised around the stems should be flattened a little at top, and even slightly hollowed out near the stem, to collect the dews and rains in dry seasons. If any tillers or shoots appear from the bottom of the stem, they should be carefully removed, as they diminish the nourishment which should go to the main stem. A fourth hoeing and earthing up, at the time when the seed begins to swell, is useful, but seldom given, for fear of unnecessary expense. In many countries they sow or plant various vegetables in the intervals between the rows of maize, of which the most advantageous are turnips and cabbages, which may be sown or planted between the maize, after the last hoeing. French beans, except they be dwarfs, are not so proper, as they shade the maize and prevent its maturity. In warm climates cucumbers and melons are often raised there. In Carolina, where they hoe their maize only twice, a running weed springs up rapidly, called *syntherisma*, which is much relished by cattle, and is cut several times before winter.

The time of flowering is very critical for the maize: a cold damp atmosphere may make a great part of the crop fail. In situations where this is to be feared, it is safe to sow maize at several times, with a week's interval: thus the risk is divided, and it is not so likely that the whole crop will be in flower in ungenial weather.

The male flowers, just as they expand, are excellent food for cattle: and it is usual in many places to cut off a great portion of them for this purpose. If it be done judiciously, there is no danger, provided a sufficient number of male flowers be left to impregnate the females: one in a square of about fifteen or twenty feet is thought sufficient. After the seed is set, it is customary, in many places, to cut off the whole top of the stem, with the upper leaves, and give them to the cattle; but this is by no means to be recommended: the wound thus made bleeds, and much of the sap is lost; besides the upper leaves serve to elaborate the sap and assist its circulation; they should therefore be left on as long as they are green, and other food found for the cattle.

All plants which stand too close or have no ears upon them should be pulled up and given to the cows, to give air to the rest; all those also that are very late and have abortive ears should be taken up, as they would at all events not ripen their seed. The young ear is preserved as a pickle, like young cucumbers: when a little advanced it is roasted on the coals, or before the fire, and is pleasant to eat: in the green state, when the grains are still soft and milky, it is boiled and used as a vegetable, and is considered a delicacy.

Maize is subject to diseases similar to those of wheat and other grain; and it is supposed, as observed before, that the steeping and liming may prevent them in a great measure.

When the maize is fully ripe, which it is not until the sheath of the ear opens and appears quite dead, the ears are twisted off by hand and laid in a dry place; they are turned occasionally that the sheath may not become musty, and are then stored in a dry place; the seed keeps better so than when it is separated. The taking off the seeds from the ear is a laborious operation; it may be done by the flail, but it is most easily accomplished by an old blunt sword or iron hoop fixed over a tub. The ears are rubbed hard over this edge, and the seeds fall into the tub. They have a simple machine in America, which does the work quick. The core or rachis is only fit for burning in the oven. The leaves are gathered for fodder a short time before the ears are pulled. In America and in Italy they stuff mattresses with the dry sheath, which makes a cool and elastic bed.

All animals are fond of maize, especially horses, pigs, and poultry; it gives the flesh of the two last a peculiarly fine flavour. The most profitable way to use maize in fattening animals is to grind it into meal, and mix it with warm water into a pottage; and, for horses, to soak it twenty-four hours in water before they are fed with it. In the dry state it is so hard that it wears their teeth, and in young horses is apt to produce blindness by the exertion of the muscles of the jaw in chewing it.

One of the most important uses of maize in Europe is to sow it thick, to be cut green as food for cows, oxen, and sheep. In a proper climate there is no plant which gives so great a mass of green food as maize. The produce is most abundant and nutritive. The largest varieties should be chosen. The seed may be sown in drills in April, and in September a crop may be mown, which would give admirable fodder for every kind of cattle. It is said to exhaust the land; but what will not exhaust it, more or less, which gives much nourishment? Maize will well repay the manure which may be required to restore the humus that it has consumed. If it is sown early, a second crop may be raised the same year; for it does not spring up again like grass, after being cut. Where the land admits of irrigation, the growth of the maize is most rapid and luxuriant. The time to cut it is when the male flowers are just appearing out of the sheath in which they are enveloped in the early stage of their growth. It may be dried into hay, and will keep good for a couple of years; but in this state it must be bruised or soaked when given to cattle, as the stems get very hard in drying; they may however be cut, as the cane-tops are in the sugar-plantations.

MANURE. Every substance which has been used to improve the natural soil, or to restore to it the fertility which is diminished by the crops annually carried away, has been included in the name of manure. Thus chalk, marl, clay, and even sand, when added to the soil for the purpose of improving its texture, have been called manures; and some confusion has arisen in our ideas in consequence of applying the same word to signify things which are essentially different. The French have a term by which they distinguish the substances which merely improve the mechanical texture of the soil from those which act more directly in nourishing the plants which grow in it. The former of these they call *amendements*, and the latter *engrais*. For want of another word, there might be no impropriety in adopting the first of these instead of the vaguer term of 'improving manures,' retaining the word 'manures' for those which are considered as stimulating or nourishing, and which are usually called enriching manures.

It is well known to all practical agriculturists that the texture of the soil and the proportions of the earths of which it is composed are the first and most important conditions of its productive powers. Where there is a good natural loam which retains moisture without becoming wet or overcharged with it, and permits the influence of the atmospheric air to pervade it, the crops cannot fail to be more certain and remunerating than in loose sands or tenacious clays, however rich they may be in those substances which are supposed to supply the elements from which the juices of plants are chiefly composed. But at the same time it is equally true, that the best texture of soil will not produce good crops for any length of time, without the help of dung or other rich manures to recruit the loss produced by vegetation.

The various means of improving the texture, such as tillage and the mixture of earths, are treated of separately. [LOAM; MARL; SOIL; TILLAGE.] We shall here confine our observations to that class of manures which stimulate or enrich the soil.

There are some substances which evidently belong to both classes of manure. Of these lime, either in its caustic state of quick-lime, or its milder form of a carbonate or chalk, is the principal. Lime, being an earth less porous than sand, and more so than clay, has an improving effect on soils in which either sand or clay prevails; but it has also a chemical effect as an alkaline earth, and, considered in this light, it acts on the soil in a peculiar manner, and greatly assists the effect of enriching manures, which are all of animal or vegetable origin.

Lime as a manure acts most powerfully in its caustic state, that is, when deprived of the carbonic acid which is generally united with it. The carbonic acid is expelled by the heat of a furnace or kiln, and limestone or marble is by this means reduced to the state of quick-lime. The water of crystallization, which makes the particles of marble or limestone adhere in a solid form, is driven out by the heat, which reduces it to a light porous stone, very readily pulverized, and having so strong an attraction for moisture and carbonic acid, that, if it be left exposed to the atmosphere for any length of time, it absorbs both from it, and gradually returns to the state of hydrate and carbonate, or lime united with water and carbon, with this difference, that it is now a fine impalpable powder, instead of a hard stone.

Lime newly burnt has a peculiar effect upon all organic matter, which it burns or dissolves by taking from it a portion of the water and of the carbonic acid which it contains. On humus, which is the result of animal and vegetable decay in the earth, it has a peculiar effect, rendering it soluble in water, and thus fit to enter the minute fibres of the roots of plants. This circumstance is probably the secret of all the wonderful effects of lime on certain soils, while it appears almost inactive in others. In some places, where the soil is peculiarly poor, being evidently a pure silicious sand washed by the sea or by rivers, lime is found to do no good; but on the rich alluvial clays, which contain much organic matter, it is the best of manures, both in a caustic and mild state.

Caustic lime readily unites with the half-decomposed fibres of vegetable matter, such as straw, heath, and the like; it helps their decomposition and accelerates it; by its means the dead fibres of the roots of vegetables, which remain in the earth when the plant is removed, become soluble; and their elements, entering into new combinations, supply the materials for the various vegetable substances which are naturally produced. As long as there is a store of organic matter or humus in the soil, lime will be an excellent manure; as soon as this is exhausted, it will only add to the sterility by destroying every fibre which the seed might throw out from its own substance by the assistance of light and moisture. This will account for the various reports which have been made at different times of the effect of lime when put on land. In some instances the quantity which might be safely used appeared almost unlimited, in others a very small portion exhausted the powers of the soil.

Agricultural experiments are seldom conducted with sufficient precision. The man of science in his study operates on a minute portion of soil, and his experiments on vegetation are carried on at best in a few feet of garden-ground. The farmer is occupied with too many things to mark the minute differences which affect the results. Where lime has been found useful, and a good crop has been obtained by the abundant use of it, land is limed as often as can be done, with the same expectation of success. The same may be said of chalking and marling: if one application has done good, another, it is supposed, will be equally beneficial. On the same principle quack doctors pretend that their medicines not only cure the diseased, but should also be taken continually by persons in health to prevent disease. The ignorant only are the dupes of these professions. Lime is a most excellent manure, and, when properly applied, most beneficial; but it may become inert, or even noxious, when applied injudiciously.

The property to which lime owes its chief power in promoting vegetation is, its combining with certain elements of decayed animal and vegetable matter, and forming a compound which is soluble in water, and which attracts carbonic acid and moisture from the atmosphere. This substance is readily taken up into the sap by the fibres of the roots, and supplies the plant with oxygen, hydrogen, and carbon, which are the elements of all vegetable substances, if we except a few which also contain nitrogen, one of the component elements of the atmosphere. Thus we see that air, water, and carbonic acid are sufficient to afford all the elements of vegetables, and that the use of the lime is chiefly to facilitate the absorption of these elements, besides depositing a very minute portion of the pure earth in certain parts of the vegetable. Thus far lime acts as a solvent, in the same manner as alkaline salts, which, in a much smaller quantity, would have the same effect. The alkalies are seldom used as manure in a pure state, but they abound in ashes, seaweeds, and all woody fibres of vegetables;

and when these are used as manures, the alkali produces its effect. Lime, being so much more abundant, and obtained at comparatively little cost, is preferred. But lime, besides its effect on the humus in the soil, acts also on the clay which it may contain; and where this is abundant, its effect is most beneficial. For this purpose it need not be in a caustic state; and chalk, which can be used in much greater quantity, from its abundance in many parts of England, effects a much more permanent improvement in the soil. But chalk acts also chemically wherever acids exist in too great abundance, whether they be mineral or vegetable: it neutralizes these acids, and in doing so generally gives out some of the carbonic acid which it is combined with: and this, before it is quite expanded into gas, is readily taken up by the moisture in the soil and carried into the vessels of the plants, where it deposits the carbon, letting the oxygen escape by the pores of the bark and leaves.

Where limestone is abundant, and the burning of it is expensive, it is sometimes broken and pounded fine: in this state it is of great use in stiff soils. At first it acts merely mechanically, as fine sand would do; but gradually pulverising and meeting with acids, its chemical effects become apparent.

The use of quick-lime in rendering inert vegetable fibres soluble, and hastening the decomposition of animal substances, is of the greatest importance in agriculture. Substances may be rendered highly enriching in a short time, which, without it, would have lain long dormant in the soil or the dung-heap. Its effects in this way will be more particularly noticed when we treat of composts.

Wherever there is peaty matter in the soil, which, owing to the tannin principle which it contains, is, by itself, perfectly incapable of putrefaction, lime is the true remedy. Assisted by fæculent matter to produce a degree of heat and fermentation in it, lime soon dissolves peat, and converts it into real humus, than which there is no better food for vegetation. The ashes of burnt peat act in a different way; they contain alkaline salts and earths in a state of minute division. They do not furnish any substance from which a plant derives its chief increase in bulk, but they serve to prepare other substances in the earth, and convert them into manure. They have also some effect in stimulating the action of the vessels which elaborate the different juices, as culinary salt has on the stomach of most animals. At least there is every reason to think so from analogy in the absence of positive proof. From all this the practical use of lime, chalk, or ashes is readily deduced. In a very stiff clay, chalk or lime will render it much more porous, and admit the influence of the atmosphere; it will correct acidity and assist the nutritious effects of animal and vegetable manures. Quick-lime spread on a soil abounding in vegetable matter will make it active by dissolving the half-decomposed fibres and converting them into a soluble mucilage: being extremely minutely divided by its property of attracting moisture rapidly, a very small quantity produces an immediate effect. Hence it is generally spread over fallows or clover-leys, which are preparing for wheat-sowing. If it were put on the land long before the seed is sown, it would have lost its chief power by attracting carbonic acid and returning to the state of carbonate or chalk, and all the expense of burning would be thrown away, except as far as it has thoroughly pulverised it. But frost does this with chalk spread before winter at a much cheaper rate; and a good dressing with chalk will last in the soil, and its effects be preserved, many years after all the lime would have disappeared. It is therefore a matter of mere experiment and calculation whether it be more profitable to put ten waggon-loads of chalk on an acre of stiff clay, or one or two waggon-loads of quick-lime. If the soil be very tenacious, the chalk will probably be the most profitable in the end, as well as the cheapest; but for a few crops the lime may appear to have the advantage. Everything depends on situation, and the comparative facility with which lime and chalk can be procured.

On poor sands chalk will be found to produce a greater and more permanent improvement than the same value in lime, which, unless it be mixed with clay or vegetable substances, will not be of great use on such soils. When marl can be procured, or clay and chalk, these will be the best correctives for the porous nature of sand, whether mixed by nature or artificially. But marls are chiefly amendments, and as such will be noticed separately. [MARL.]

The substances which have generally been used as manures are numerous and various, and have been divided into stimulating and nourishing manures. All saline substances are ranked under the first, and all organic matter under the second.

When ignorance sheltered itself under vague terms, the fertility of the soil was attributed to the general term "salt" or "nitre," both very undefined substances, which led to errors, instead of promoting the investigation of truth by observation. Nitre was supposed to exist in dews, rains, and snow. All vegetables were supposed to consist of salt and earth, or more properly of soluble and insoluble substances, and on this uncertain foundation theories were built and practices recommended. It was said that when the soil was fallowed it imbibed nitre from the atmosphere, because it was known that animal and vegetable matters decomposing in a heap of earth gradually produced nitre, which, although it did not actually absorb it from the air, was certainly generated by combining the elements of atmospheric air with the alkali which existed in the organic matter; and, as the earth from which the nitre was extracted was an excellent manure, from the remaining portion of organic matter in it, it was supposed to be the effect of the nitre which remained. That nitre may be of use in some cases we will not deny; but there is not the slightest foundation for believing that it is the real pabulum of plants, or that the soil owes its fertility entirely to its presence.

From the most accurate analysis of the component parts of plants, it is ascertained that salts and earths form a very inconsiderable portion of their substance, and that carbon and water furnish by far the greatest part. The nitrogen of the atmosphere is found only in some of them, and all metallic substances seem entirely adventitious.

It has been supposed that all the carbon in plants might be supplied by the atmosphere, but this is not supported by any proof; on the contrary, plants will not thrive, unless there be in the soil in which they grow substances which contain carbon, that is, chiefly animal and vegetable substances, and chalk. The two first readily part with it, but the latter retains it too strongly to lead us to conclude that the plants draw any of it from this source, unless where a stronger acid is present to release the carbonic acid by its greater affinity to lime. We may conclude then, that from whatever source the oxygen and hydrogen of vegetable substances are derived, the carbon comes from the decomposition of organic substances, either animal or vegetable, and that these, in a certain state of decomposition, afford the supply of carbon by which the plant increases and secretes its juices. As in the animal digestion the chemical affinities, as observed in the raw materials, seem all to be set at defiance, or greatly modified by a vital energy of that organ, so in the conversion of the simple vegetable sap, differing but little from pure water, into the various substances which are produced by vegetation, no analogy can be drawn from the experiments of the laboratory. Nature alone has the secret of transmutation, and it is only by watching her operations and endeavouring to imitate them, that we can hope to come to useful practical results.

These preliminary observations are necessary to the consideration of the comparative importance of various substances used as manures.

The first and most important class of manures are the excrements of animals. The peculiar property of earth in absorbing putrid effluvia and removing disagreeable smells, appears an indication of nature to lead us to bury putrid animal substances, of which the excrements and dead carcasses of animals are the most numerous and obvious. It would require no length of experience to show that wherever this is done vegetation is more vigorous. There is therefore another motive for burying dung than merely to get rid of a disagreeable substance. From the most ancient times of which there are any records, the dunging of a field has been an important part of cultivation. The preparing of the dung of animals, so as to render it more efficacious, is a later improvement, and has not yet attained the perfection of which it is capable, unless it be so in China, of which we read wonderful accounts. The fresh dung dropped on the ground, far from improving the herbage where it has fallen, appears to injure it, and render it unfit for cattle to eat; when it gradually disappears, and not till then, the spot is restored to its former verdure. But if the dung is dug into the ground and covered with earth, the fertilizing effect will be immediately perceived. This is a sufficient lesson to the husbandman to make him bury the dung as soon as possible. But this not being always practicable, it is collected in heaps until it can be carried to the land prepared for its reception by ploughing or digging. By mixing the straw, which has served as litter to cattle, with their dung, the quantity is increased, and by allowing this mixture to heat and putrefy, a greater quantity of manure is produced. This is probably the history of the dunghill. Science has seldom been applied to show the most profitable mode of collecting dung and forming a dunghill; but experience has, in many countries, taught methods which accord well with what science might have taught. The manure must be soluble before it can be effective; this solubility can only be produced in the more solid portions, such as the straw, by putrefaction, which the dung promotes when duly moistened. All well-managed dunghills are therefore watered in dry weather, and turned over to let every portion undergo the same degree of putrefaction. The exact moment when it is most advantageous to bury it in the ground seems not yet fully decided. Some let the decomposition go on until a great portion of the heap is converted into a black, tough, oily substance, which, from early association, gives the idea of richness. It is no doubt a powerful manure which acts speedily, but is it the most economical? This may be disputed. A great portion of the substance must have been resolved into gases, which fly off and are lost. The remainder, evidently carbonaceous from its colour, has acquired too much of the appearance of charcoal to be very efficient; and it is only the exuding juice which is immediately fertilizing. The most experienced farmers agree, that whenever the brown colour of a dung-heap verges towards a black, the dung has lost something of its value, besides the diminution in its bulk by dissipation. The best state in which dung can be carried to the land is, according to the best informed practical agriculturists, when the straw is so rotten that it readily breaks into short pieces, without having entirely lost its form; it should then be of a brown or mahogany colour, uniform throughout the mass. Whenever dung is mentioned by foreign agricultural writers, it is generally understood to be in this state, which in English is called short dung.

As manure is wanted for the land at different seasons, it is of consequence that the dung from the yards and stables should be collected in such heaps, and managed so as to be in the exact state which is thought most advantageous at the time when it is carted on the land. To effect this some attention is required. The oldest portion must have its putrefaction retarded, and the newest accelerated, to bring them both to the same state. This is easily done. If a certain thickness of dung is kept trodden down by the cattle, it will be a long time before it decomposes, nor will it do this without being turned over to expose the under portions to the air. If, on the contrary, it be carried out into a heap in a loose state, and occasionally turned over and moistened when it appears dry, it will heat and be ready in a very short time. When a sufficient quantity of short dung can be carried to a field prepared to receive it, and immediately ploughed in with a shallow furrow, it will soon incorporate with the soil, and afford a succession of soluble humus or mucilage, which will give regular nourishment to the plants. This is said on the supposition that the soil is in that state when it only requires recruiting, and has a texture favourable to the crops raised upon it.

In poor sands or wet clays some modification in the state of the dung may be necessary.

In speaking of dung, we have not said anything of the different kinds of dung produced from different domestic animals. In some cases it may be advantageous to keep these separate; for instance, the dung of cows from that of horses, of cattle feeding on oil-cakes or grain, with or without turnips, and those fed on straw or refuse hay only. Cow-dung, when in a fresh state, is thought best for light soils, and horse-dung for cold heavy soils. The richer the dung, from the nature of the food given to the animals, the less of it need be used, and this may be worth attending to. But in general a mixture of the dung of all the different animals kept on a farm, with all the straw that can be afforded, will give a manure of an average strength, which may be used upon all kinds of land; with this difference, that for light soils it should be more decomposed than for the heavy, and also ploughed in deeper; for the air penetrates the light soil to a greater depth, and sooner acts on the manure. In heavy land the straw, if not so much decomposed, will form cavities to let in the air, and allow of a more regular evaporation. All this is well known to most farmers, but not always strictly attended to. It is better to manure slightly and often than to put on a large quantity at once, except for some particular crops, which require a rich earth and consume much manure, such as potatoes, beet-root, and ruta-baga, or Swedish turnips, whatever some authors may write to the contrary, led away by the old notion that roots impoverish the soil less than seeds, which is not universally the case. Any one who has raised the above-mentioned roots with the usual manuring, and drawn them off the land to be consumed elsewhere, will acknowledge that his subsequent corn was far inferior to that which had succeeded beans, tares, or clover, with the same quantity of manure. Those who do not agree in this opinion may readily be convinced by a fair trial.

The chief use of cattle on an arable farm, besides those which are necessary for the operations of husbandry, is to produce manure for the land. If the cattle repay their food and the expense and risk attending their keep, the manure is sufficient profit. Even with a moderate loss, they must be kept, when manure cannot be purchased; and a portion of the land must be cultivated solely for the maintenance of cattle. In some poor soils one-half of the land is not too much to produce manure sufficient for the other half. The loss, if any, on the cattle must be repaid by the increase of the corn crops. Manure is to a farm what daily food is to an animal; it must be procured at any sacrifice. It is better to let land remain uncultivated in rough pasture, as was once the case with a great part of Britain, and is still the case with extensive tracts on the Continent, than to break it up without having the means of manuring it. A few crops may be obtained at first, but the land is deteriorated for ever after, and what has been obtained from it is dearly paid for.

Various means have been adopted to increase the quantity and efficacy of manure. The simplest is, to increase the number of cattle, and husband their manure. It is evident that to let cattle run in loose pastures is a great loss, not only on account of the dung which is dropped, and more than lost, but also the urine, which contains the very essence of manure. In all countries where stall-feeding is practised, the lands are highly manured, and the crops more certain and abundant. With this system is connected a much more economical management of the manure, by keeping the litter and more solid parts of the dung separate from the urine and liquid parts, which are collected in large reservoirs, and used either in the liquid state, and applied immediately to the land, or in the formation of compost heaps, with earth and vegetable substances collected for the purpose, and the straw which has served for litter. As this is a subject not generally known and seldom carried into practice in Britain, we will dwell a little upon it, availing ourselves of the information obtained from other countries, particularly from the husbandry of Flanders, of which an account has been published in the Farmer's series of the 'Library of

Useful Knowledge,' Nos. 105, 106, and 107.

When the urine and a considerable portion of the solid dung are washed into a reservoir immediately from the stables, its strength can be much more readily ascertained than when they are mixed up with straw and thrown into a yard. The specific gravity of the liquid is readily ascertained by an instrument, and those who are in the habit of observing this liquid manure can judge most accurately of its strength, and of the degree of putrefaction which it has undergone.

Notwithstanding some apparently contradictory opinions, it is pretty generally acknowledged by those who have had long experience of its use, that urine and similar animal substances have a more powerful effect on the soil, when they have undergone a certain degree of putrefaction, than when they are used in a fresh state, and that this is produced with the least loss of substance when the liquid has been confined in close vaulted cisterns which admit the external air only partially. On light soils this liquid has a most fertilizing effect, if it is used in small portions at a time. On very heavy soils this effect is not so apparent, and for such soils the liquid is accordingly mixed with sand or any light earth before it is applied; or, instead of using it at once upon the land, it is poured over the litter, which has been collected in a heap or in a yard, after having served for the cattle. This litter, having been deprived of the urine which would otherwise have mixed with it, would rot very slowly and produce a very inferior kind of manure, unless it were moistened, and fermentation were excited by pouring the half-putrefied urine over it. It may be objected that if the urine is only collected to moisten the straw which has served as litter, it would be as well to let it be mixed at first, without the trouble of pumping it up and the expense of a cistern to hold it. But we shall soon see that there is a very wide difference. In the common mode of collecting farm-yard dung, the straw is very unequally impregnated with animal matter: at one time it will contain a large portion and run rapidly into fermentation; at another, there will be so little, that it is with difficulty that heat is excited in it. By separating the urine and litter, the straw will go much further, and can be mixed with the urine at the most advantageous time: thus it forms a much richer manure in a smaller compass, from not being so much diluted with water. Should there be a deficiency of straw, earth or sand will supply its place, in as far as soaking up the rich juices; for the addition to the manure from the decomposition of the straw itself is very small in proportion to that which animal juices afford. If the liquid is collected from a stable or a yard where cattle are kept as soon as it is produced, and is carried off into a cistern, there will be a much better and drier bed left for the cattle, especially if the rain is kept off by light shades. When the litter is soiled to a certain degree, it may be removed to a heap in a proper place, where its conversion into rich dung may be effected by the addition of putrefying urine, than which nothing will so soon rot vegetable fibres, if the air be admitted to the heap. The portion which is not wanted for some time may be left to decompose more slowly; and as the time approaches when it is wanted for the land, it may be managed so as to be in that state which experience has shown to be most effective in the improvement of the crops.

There is some appearance of certainty and regularity in this mode of making a dunghill, which there scarcely is in the common practice of accumulating straw, dung, and urine without any regularity in a farm-yard, turning it over when the cattle leave it for the pastures, and carrying so many cart-loads per acre on the land to be manured, without any measure of its comparative strength. One portion is often almost burnt black, and another appears like the fresh litter of the stables, not being even thoroughly soaked with moisture. It is true that good farmers pay more attention to their dung-heaps, and endeavour to carry out the manure in a proper state; but how much more readily would this be accomplished by the help of a large cistern, full of the richest animal matter, in a state of partial putrefaction. In those situations where straw bears a high price, it may be doubtful whether a cistern might not permit a considerable profit to be made by the sale of a portion of the straw, without any diminution of the manure required for the farm, since for light soils the liquid might be used alone, and for stiffer soils it might be mixed into a compost with earth, chalk, and any kind of refuse vegetable matter of less value than straw. It was an opinion expressed by a celebrated agriculturist* to the writer of this article, that he considered the use of straw in dung to be merely as a sponge to hold the liquid animal matter in its pores or tubes. In fact, straw or old thatch merely rotten by long exposure to air and moisture is of little or no value as a manure, although it will sometimes produce good potatoes, by rendering a stiff soil pervious and porous; but, in a light soil, a gallon of urine is worth ten times its weight of rotten straw. This doctrine may appear strange to some agriculturists, but it will bear the test of experiment.

The great use of liquid manure on light soils is to impregnate them with soluble matter, which, being diffused through their substance, supplies nourishment to the roots of plants, wherever they may shoot out. It may be applied to the land at any time before the seed is sown, and soon after, when the blade springs up or the seed begins to form; in short, whenever the plant requires fresh nourishment, or when that which existed in the soil is diminished. Without liquid manure, the poor silicious sands of Flanders could never be cultivated, much less produce crops which vie in quantity and quality with those on the best soils. The quantity of farm-yard dung, in a very rotten state, which this soil would require according to the common system of manuring, could never be produced by all the straw which can be raised upon it in its first state of cultivation. But cattle produce urine, and this produces roots for cattle. The great effect of liquid manure has set the farmers on finding some artificial substitute for the simple urine and diluted dung of cattle. Such substitutes are obtained by mixing all kinds of refuse animal matter with water, and inducing putrefaction. The emptyings of privies from towns is scarcely a substitute; for it is the same as the liquid from the stables in a more concentrated form; but the refuse of oil-mills and various manufactures, when diluted and mixed with a portion of putrid urine, soon become assimilated to it. This becomes a branch of trade in those countries where nothing will grow without manure, and is a resource where an increasing population demands the cultivation of inferior soils to supply the necessary increase of food, as well as an increase of produce from those which are naturally fertile.

The increase of manure by the formation of *composts* is well known in many parts of Britain, and by their means the land has in many districts been rendered much more productive. The fundamental principle upon which composts have been made, is that of impregnating portions of earth with those parts of the dung of cattle, which, from want of management in the common dunghills, would have been dissipated and lost; and also accelerating or retarding the decomposition of animal and vegetable substances by the addition of earths, such as chalk, marl, clay, and even sand, according to the nature of the soil on which the compost is to be used. All solid manure which is to be ploughed into the ground, should contain certain parts already soluble in water, which promote vegetation: while other portions should be in a progressive state, so as to afford a succession of soluble matter by a gradual and slow decomposition. Though we have set forth the value and importance of liquid manure, and suggest the best mode of applying it, we would guard against its being supposed that solid dung may be altogether superseded by liquid. Liquid manure, however active and immediately effective, soon loses its power; whereas solid dung, well prepared and ploughed into the ground, will last for several crops. It is the judicious use of both these manures, conjointly, which has the best and most permanent effect. The dung or compost, having been ploughed in well, requires some time before it can have any direct effect on the germination of the seed or the nourishment of the plant. The liquid, on the contrary, acts from the moment it is poured on the surface. It is the milk of the young plant, which thrives upon it and stretches out its fibres through the earth, till it reaches the dung, which, having undergone that slow transmutation which forms humus, is now in a proper state to supply the more vigorous roots with sufficient nourishment. It is evident that the growth must be more rapid and regular, and not so liable to be checked from want of proper nourishment, nor are the young roots in danger of perishing by being too soon exposed to the immediate contact of rank dung. Every exertion should therefore be made by the industrious husbandman to increase the quantity and improve the quality of every species of manure, both solid and liquid: and here careful experiment can alone be depended upon. Sir Humphry Davy, who so much enlarged the sphere of chemical science by his discoveries, hastily asserted that the dung from the stables and yards should be buried in the soil as soon as possible, because when it is collected in a dunghill a great portion of volatile and gaseous matter escapes into the atmosphere. But he did not proceed to show whether the ammonia or hydrogen which escapes would have been of any use in the soil; perhaps this exhalation, instead of diminishing the value, or even the bulk of the manure, actually improved it. It does not appear that fermenting dung produces carbonic acid, for a man may sleep on hot dung without much danger, which would not be the case if much carbonic acid were evolved; the ammonia is produced in the very first stage of decomposition, as may be perceived in opening the door of a stable where horses have been shut up for some time; but a heap of manure does not produce the same effect when its first heat is gone off. Most observant practical farmers have followed a contrary practice, and let their dung be tolerably short and rotten before it is ploughed into the soil. The Flemings pour liquid manure on the small heaps of dung in the field to excite fermentation, before they spread it and plough it in; some, on the other hand, let the manure remain spread over the soil, rolling it in order to pulverize it some time before it is ploughed in. Without pretending to decide between these opposite practices, we will venture to affirm that, until more light is thrown upon the process of vegetation and decomposition, the sure experience of the farmer is more trustworthy than the most plausible theories of men of science, unless they are supported by numerous and accurately conducted experiments on a large scale.

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* Mr. De Fellenberg, of Hofwyl, near Bern, in Switzerland.

In the formation of composts the principal objects are, to regulate the decomposition of the organic substances, and to increase the bulk of the manure by means of less expensive materials than straw. For these purposes lime or chalk is generally used: the former, in its caustic state, to accelerate the decomposition of fibrous matter; the latter to add to the mass, and absorb any portion of acid, which is always produced in a certain stage of the fermentation. The mode of doing this is so generally known, that it is needless to describe it: we shall only observe that the stiffest clay may be used with advantage in composts, where better soil is not at hand; and for light lands, the stiffer the clay the better, provided it be thoroughly incorporated with the manure. The most useful material, under proper management, is peat or turf. This may be laid in layers with quick-lime and earth; the whole being well soaked with liquid manure. If any kind of vegetable matter, such as fern, broom, the tops of heath, or pond weeds, can be added, it will be so much the richer. The lime and urine, acting on the peaty matter, decompose its tannin and transform it into humus, the woody fibre is dissolved, and the whole mass, when turned over and well mixed, becomes a very rich earth, which, being spread on the land and slightly ploughed or harrowed in, greatly enriches its surface. By this means many poor soils may be improved, where the cultivation is not sufficiently extended to produce straw. Potatoes grow readily in peaty soils which are drained and limed; and the potatoes when given to cattle will produce sufficient dung and urine to improve the land without much straw being used.

As a substitute for urine, several mixtures of animal and saline matters have been tried, which are supposed to resemble it in composition. There is no reason why such a liquid might not be formed artificially, and if it can be made with cheap materials, which may be obtained in abundance and at less expense than by keeping cattle, it would be a very important discovery.

Although bones have been treated of in a separate article [Bones], it may be proper to mention here, that if some easy means of dissolving their substance were discovered, they might be made of much greater use than they now are. At present they are put in with the seed in a broken state, and as they remain a long time undecomposed in the soil, their effect, after the first crop, is scarcely perceptible, unless a very large quantity is used. By mixing dissolved bones in a liquid state with earth, almost all the component parts of urine would be there.

Experiments have been made on the subject of artificial liquid manure by Mr. Kimberley, of Trotsworth farm, Surrey, and we understand the result will shortly be made public by subscription.

The various substances which are generally enumerated, as occasionally used for manure, are chiefly the refuse of manufactures, consisting of earths, salts, and organic substances. Soapers' waste is chiefly lime with a small portion of alkali. The scrapings of leather, horn, bones, and the refuse of the shambles, the hair or wool of animals, and rags made of these, may be all classed together. They must be distinguished as acting in a two-fold manner: they absorb and retain moisture, at the same time that they afford nourishment by their gradual decomposition. Hence the great effect produced by them on certain plants, such as hops, and the length of time during which this effect is perceptible, especially in dry porous soils.

It is generally supposed that animal and vegetable manures produce their effect by giving nourishment to plants out of their own substance. This is no doubt true; but it appears also that they have a power of absorption, by which they attract not only moisture, but also oxygen from the atmosphere, and probably hydrogen by the decomposition of the water Thus the elements are at liberty to form new combinations, which are assisted by the vital action of the roots. This throws no great light on the subject, but it may be kept in mind, to prevent erroneous conclusions being drawn from the result of imperfect experiments, and to put us on our guard against applying the general principles of chemistry to the composition and use of manures without carefully attending to all the circumstances and watching all the appearances. We would recommend to all practical farmers to note down every particular in the formation and application of the manures which they employ, and also their apparent effect. It will require some years to enable a man to draw just conclusions, but the data will thus be established, and more will be discovered by such a course than by all the experiments which can be made on a small scale.

There is one substance which has been highly extolled as a manure, but which is scarcely known by name in English agriculture. This is called *urate*, being a compound of urine and plaster of Paris. It is formed by mixing sand and burnt gypsum with urine, and forming a hard compound, which is afterwards reduced to powder. The Royal Society of Agriculture at Paris caused some experiments to be made with this manure for the purpose of comparing it with those which are known to be most effective, such as dried nightsoil, pigeons' dung, &c. The result was in favour of the urate for the duration of its effect on lucern in a light soil, where the portion manured with the urate produced the greatest return at the third and fourth cuttings, when the nightsoil and pigeons' dung had lost a portion of their effect. It requires a moist season to act powerfully. When mixed with dried nightsoil its effect on various crops was very great. But it does not clearly appear whether this is to be ascribed to the urate chiefly, or to the dried nightsoil. Its effect on potatoes was superior to that of the dried nightsoil. It might be worth while to repeat these experiments, which may be found detailed in the *Dictionnaire d'Agriculture Pratique*, in 2 vols. 8vo., Paris, 1828. If it should furnish a substitute for bones, it would be very valuable, as it could be obtained to an almost unlimited extent from large towns.

The ashes of vegetable substances which have been burnt in the open air contain a great portion of potass, with some fine earths. They are consequently very effective in stimulating vegetation on lands which contain a good portion of humus. They are chiefly used as a top-dressing on young clovers and grasses; and whenever there is an appearance of sourness in the grass, wood-ashes are of great use. It is, however, seldom that wood-ashes are used as manure until the greater part of the alkali has been extracted; but when the surface of the land is pared off and the dry sods are burnt, the ashes which result from this operation are very effective in producing a good crop without any other manure. [PARING AND BURNING.] The refuse ashes from bleachers' and soap-boilers' premises have still some portion of alkali in them, and as they contain lime and other earths in a very divided state, their effect on the soil is very perceptible. Sea-salt has been extolled and decried at different times, owing probably to the different circumstances under which it has been tried. In a very small quantity sea-salt may have a beneficial effect on the soil. Urine contains a great deal of it, and in the formation of composts sea-water has been found to hasten the putrefaction of the animal and vegetable matters which they contained, probably by absorbing moisture, which is essential to putrefaction. Quick-lime slacked with sea-water and mixed with sand forms a mortar which attracts moisture so strongly that walls built with it are scarcely ever dry. This suggests a mode of supplying the soil with moisture, and may account for the effect of salt in particular cases.

The experiments which have hitherto been made on artificial manures have not been sufficiently varied to lead to any very accurate conclusions as to their comparative merits, and the results have not been stated with the minuteness which would make them a foundation for practical rules. There is a wide field open to the chemist and the scientific agriculturist, and many important discoveries no doubt would be the result of patient and accurate investigation.

MANURING, in horticulture, requires to be considered in a somewhat different light from that process as applied to agricultural purposes. This is necessary because of the variety of plants, possessing different constitutional habits, to which the gardener is required to turn his attention, and also because of the different results which are expected in horticulture and agriculture. In preparing the present article the writer has confined himself to simple practical facts, and has adverted only occasionally to chemical explanations. In the present state of our knowledge of that branch of inquiry, improved as it is since the time of Davy, opinions are still too vague and unsettled to afford the cultivator a satisfactory solution of the physical problems suggested by the commonest facts in the art of manuring.

The gardener is called upon to cultivate species from almost every kind of soil on the surface of the globe, intermediate between the shifting sands of the desert and the most fertile alluvial land continually enriched by the decay of vegetable and animal substances. It is therefore obvious that considerable caution is requisite in applying manure and in determining the quantity or quality suited to the respective constitutions of the various subjects which the horticulturist takes under his care. Thus, although many plants can scarcely receive too much manure, others, such as the resinous trees, are actually killed by it.

The kind of manure chiefly used, and frequently the only kind procurable by the gardener, is that derived from the farm-yard; consisting chiefly of the dung of horses or of horned cattle, more or less mixed with litter. Formerly it was very generally the custom to take advantage of the heat resulting from the fermentation of such dung in hot-bed forcing, and there are still some objects for which this kind is found preferable [HOT-BED]; but since the hot-water system of heating has received so many improvements, the continued fermentation and consequent degree of decomposition which dung undergoes in hot-beds is rendered a less important means of obtaining artificial warmth, and consequently it becomes the more important to inquire whether manure is most beneficially applied in a state of decomposition, as some have advocated, or in a state as recent as possible, no fermentation being permitted previous to its deposition in the soil.

It is said that rotten dung contains more *humus*, weight for weight, than fresh dung. But the experiment, in order to be just, would require to be tried with two equal quantities of fresh dung, one of them being analyzed at the time, and the other after being subjected to the requisite degree of decomposition; for the latter process will of course occasion a diminution of weight, which ought to be taken into account. If the fertilizing power of manure can be proved to be in proportion to the quantity of *humus* which it contains, and if the quantity of this be as great as in the more bulky form of unrotten dung, the concentrated state would certainly be preferable, in point of economy, on account of the saving in labour and carriage; but in the present state of knowledge this cannot be asserted, and until theories become reconciled with each other, and with experience, the latter must form the only safe guide in practice.

If dung contains a large proportion of litter, and particularly if the latter be in a dry state, it will be advisable to subject it in nearly all cases to a moderate degree of fermentation, assisted by a sufficient quantity of moisture, in order that the fibre of the straw may be reduced into a state permeable by the spongioles of plants, and either become sufficiently dissolved for affording nourishment itself, or serve in the first instance as an absorbent reservoir for substances of still greater solubility. Where such preparation has not been attended to, litter has been frequently observed, when turned out of the ground after a dry summer, to be still in a dry musty state, having evidently been of little benefit to the crop; and in the case of many plants, which require much manure, litter in this state would actually prove very injurious. But if the dung be what is termed short, containing little straw, and that well saturated with the liquid proceeds of the stalls, it may be dug in without fermentation for most kitchen-garden crops, provided it is well divided and properly mixed with the soil in digging or trenching in. This is necessary in all cases, but more especially so when the manure is applied fresh: for disease is often induced by the roots entering into masses constituted of particular substances which either wholly or, at all events, too powerfully predominate over the proper nutritive solutions.

But on the other hand, if the soil is of a wet and stiff nature, then long unrotted dung is most proper, because its straws form so many minute drains, which, to speak technically, keep the ground open; and in such soils, by means of littery manure and drilling, a crop of potatoes, for example, can be raised very superior in quantity and quality to that obtained from the application of rotten dung. In this case the previous reduction of the fibre of the straw is not requisite; for the moisture of such soils is sufficient to effect this by degrees, and whilst the process of growth is going on. The authority of Miller may be adduced on this subject: in his 'Gardener's Dictionary,' he observes, "In very cold moist land, I have frequently seen new horse-dung buried as it came from the stables, and always observed that the crops have succeeded better than where the ground was dressed with very rotten dung."

On the other hand, dung that has been moderately fermented, and frequently turned over, so as to be easily cut with a spade, is the most proper for such trees as require manure, or for slow-growing crops, where the roots have to remain for years in contact with it. If the heat arising from fermentation do not exceed 100° Fahr., Sir Humphry Davy considers that but little loss will arise from the process. With regard to trees and many perennial plants, no more injury would be incurred by using fresh dung instead of rotten, for the first season, or rather whilst vegetation continued active; but after the roots become nearly dormant canker or disease of some sort is apt to ensue. The roots may have grown luxuriantly during the summer; but when they are arrested by the approach of winter, decomposition will still be going on amongst the materials on which they feed, and these materials may perhaps be chemically changed, at all events vitiated for the purpose of nourishment, before the roots are again called to action.

These remarks relate chiefly to the description of manure which is most generally used. Other substances which are or may be successfully applied to promote the growth of vegetation are exceedingly numerous; and although it would be impossible to particularize them, they may nevertheless be made sufficiently known by stating that they consist of—

1. All animal substances without exception.
2. The excrementitious secretions of all animals.
3. All kinds of vegetable substances in one state or another.
4. A few mineral substances, of which one of the principal is lime.

Animal substances are very powerful manures, and require to be attenuated or diluted before plants can derive nourishment from them, or in fact before either roots or tops can be safely brought within their contact. If the roots of a plant be wholly immersed in oil or in blood, that plant will be destroyed. Blood is one of those liquid manures which is occasionally supplied to plants so situated as to render bulky manure inapplicable; but it should unquestionably be copiously diluted with water. Oily manures, such as blubber, for instance, which will not dilute with water, must be divided by earthy matter or other substances, by which means a large surface will be exposed to atmospheric agency. Oil is impervious to air and water; and it may be taken as a general rule, that all substances impervious to these elements are unfit for the purpose of vegetable nourishment, and must therefore be subjected to some mode of decomposition in order to render them available. Supposing a mass of oily substance equal to one cubic foot were isolated, the surface exposed to the oxygen of the air (by which soluble matter in such substances, according to Sir Humphry Davy, is produced) is 864 square inches. If however this mass be separated by any substance sufficiently porous to admit air, such as earth, the air will pervade every interstice, and the requisite decomposition will be rapidly brought about. Bones are another form of animal matter much employed, and of considerable energy, especially in calcareous soils, provided they are reduced into small fragments and fermented before being used. Gardeners often use them in that state for forcing strawberries, and, reduced to dust, as a top-dressing for lawns.

The liquid portions of excrementitious manure likewise require either to be diluted with water or to receive an admixture of soil before they are brought in contact with the roots of plants. In the case of trees with roots lying deep in the ground, such dilution is not always necessary; but, generally speaking, adherence to the rule is advisable.

Sir Humphry Davy recommends covering dead animals with five or six times their bulk of soil mixed with one part of lime. This, when mixed, it may be observed, will still form a very strong manure, and for some plants much too strong; but for such as the vine it will form a valuable compost, particularly if broken bones are mixed with it.

Manures derived from the vegetable kingdom require little preparation if they consist of such plants as are chiefly parenchymatous, such as the brassica tribe; their substance is easily soluble, and they may therefore be turned fresh into the soil. The period of their growth when this is most beneficially performed is before they run to seed Weeds may even be used with great advantage, if properly prepared; but bad consequences may result from their seeds rendering the ground foul, and thus occasioning much expenditure of labour to extirpate them again. Seeds, it is well known, will not germinate without air; but with this, and sufficient heat and moisture, nothing can prevent them from germinating. Therefore if weeds be thrown into a heap and turned, whilst at the same time fermentation is encouraged till the heat is fully equal to that which would naturally cause the germination of the seeds, taking care that the outside be turned into the centre, no danger will arise from using such manure after the process has been continued sufficiently long for the germination of the slowest vegetating seeds which the heap may contain, because under these circumstances the young plants will be continually perishing as the heap is turned over from week to week. There are many aquatic plants that will not grow on dry ground, and a preparation similar to the above is not essential for the purpose of killing their seeds before their application to dry ground, which is not, as it were, their proper element.

Yeast is a powerful vegetable manure, especially if employed in a state of putrefaction; but it requires to be diluted with water till it appears of the colour of very small beer. Applied in that state, it has extraordinary power in stimulating the growth of annual crops of all kinds; but its effects are by no means permanent; for lawns however it is a restorative manure of great value. The same may be said of malt-dust.

It is observed by Sir Humphry Davy that mere woody fibre seems to be the only vegetable substance that absolutely requires fermentation to render it nutritive to plants; and he instances tanners' spent bark as a substance very absorbent and retentive of moisture, yet not penetrable by the roots of plants; or it might rather have been said, not capable of affording nourishment, from the predominance of some noxious principle, which requires to be decomposed; for when this principle is broken down by fermentation, plants, as may be observed in bark-beds, root very readily in tan. This deleterious principle is the tannin which bark contains, and the reason of its noxious effects upon plants is that it precipitates the azotized matter in which roots abound, and the presence of which, in an organizable state, is indispensable to the existence of roots. (Payen, in *Ann. Sc.*, new series, iii. 18.) Inert peaty matter is a substance of the same kind, and will remain for years exposed to air and water without undergoing change. When peat becomes inert, it is in vain to attempt to grow any sort of plant in it; but nothing is more certain than that if drained of stagnant moisture and mixed with lime and dung, it will become very fertile for most crops. It often happens that peat or bog-mould, frequently procured at a great expense for American plants, becomes inert: in such cases a good result would be obtained by turning out the peat and mixing it up in a heap with a quantity of leaves or fresh litter sufficient to promote a moderate degree of fermentation; then, as in the case of tan, it will afford nourishment, and will, from a state of uselessness, become valuable.

Of mineral manures, lime is the most useful. It is not recommended for soils that contain a large proportion of soluble vegetable matter; but it produces excellent effects in such as abound in inert vegetable fibre. Gypsum, which is found in the ashes of grasses, is a good manure for lawns.

Common salt is sometimes employed in minute portions, especially in combination with vegetable matter, in the instance of sea-weeds, in which case it is found of good quality for fruit-trees and kitchen-garden crops; but vegetable life is certainly destroyed by it, if applied in any considerable quantity. Exceptions may be noticed in the case of marine plants; the Samphire (Crithmum maritimum), for example, requires it when cultivated in inland districts; and this is also true of the vegetable inhabitants of the great salt plains of Asia. Wood-ashes, which consist principally of vegetable alkali united to carbonic acid, are a good manure, but of short duration, and they leave peaty soil in a worse state than before their application. The burning of such soil cannot therefore be too much reprehended, although strongly advocated by some who have been led away by the immediate result of one or two enormous crops. The application of dung and lime, of composts of clay, marl, scourings of ditches, &c., would render peat permanently fertile: more especially so when draining is judiciously attended to.

There is no considerable number of plants to which manure is prejudicial. Coniferous species of all kinds are affected most injuriously by it, and it requires to be given very sparingly to all trees which yield gum in their bark, especially stone-fruits, such as cherries, plums, peaches, and nectarines. To many however it appears to be useless; orchidaceous plants, for instance, which it is now the fashion to cultivate so extensively, seem insensible to its application in any form yet thought of; and American plants in general scarcely require it, unless the peat in which they are grown be regarded as a kind of manure.

MARKETS, AGRICULTURAL.—The more numerous markets are in any well cultivated country, provided they are at a sufficient distance not to interfere with each other, and on different days of the week, the greater saving there is of time and labour of conveyance. Good roads or navigable rivers are of great importance to a market-town; and if there are mills in the neighbourhood, where corn can be ground, they will increase the advantage to the farmer by causing a regular demand above what the immediate consumption of the place may require.

The vicinity of a good market, where every kind of agricultural produce will always find purchasers at a fair price, greatly adds to the value of a farm, especially if good roads lead to it; and the advantage is the greater if it be a populous town, which not only consumes much produce, but from which various kinds of manure may be brought by the teams which have carried the produce to market. It is this which so much enhances the rent of land near London and all great cities, and makes the agriculture there approach nearer to horticulture, which entirely depends on extraneous manure.

Few things are so bulky as corn: a sack weighing 240 lbs. when brought to market may be worth a guinea or thirty shillings, but if it is carried fifty miles to a market, the net value will be much reduced; and if at that market there is no demand beyond what is required for the immediate neighbourhood, and no means of exportation, a very small surplus will glut it, and reduce the price still lower. The nature and situation of the markets are consequently a most important consideration in any agricultural enterprise. Where markets are very distant, the only profitable produce is live-stock, which can be driven a long way at a small expense. All countries, however fruitful the soil, which are thinly peopled, and have no ready markets for corn, must necessarily remain in pasture or be uncultivated. An increase in the population and the establishment of manufactures give rise to an increased number of markets, and bring more land into a state of profitable cultivation as arable land. If a regular supply of food is essential in a manufacturing population, so the demand for it causes more to be produced. A regular supply to the markets keeps prices regular, fluctuating only according to the abundance or scantiness of the crops.

It is for the general advantage that the farmers should bring their corn in regularly, without speculating on a rise or fall of prices. As a general principle, a farmer should thrash his corn at a time when the work out of doors is less important, or when the weather is unfavourable for it. He must do so whenever the fodder for his cattle diminishes, and a fresh supply of straw is required: and as soon as the grain is in sufficient quantity to require a team to take it to market, it should be sold. But many circumstances may make this regular course inconvenient. There may not always be a demand for the article; and if a sale is forced, a diminution in the price must be submitted to. In some situations purchasers cannot always be found, at any price, and a granary to store corn in becomes indispensable. In commercial countries there are always speculators in corn, who make their profit by buying and selling the commodity. The farmer is tempted to withhold his corn when the price is low, in order to have a greater profit when it rises; and, to a certain degree, he is justified in doing so: but if he speculates on his own corn, when he can obtain a fair price for it, he becomes a merchant, as much as if he purchased to sell at a profit. When there is a good market at hand, the produce of the farm should be regularly sold, so as to give the farmer a constant supply of money for his operations. besides a portion set apart for the rent and other regular payments. In this way he will, at the end of the year, have had the average price, without risk and without speculation; and by a little caution he may obtain somewhat more than a mere average, provided he has always more money at hand than his immediate wants require, and is never forced to sell.

In order that the farmer may not be imposed upon, he must either make himself acquainted with the transactions in different neighbouring markets, or he must rely on the honesty and judgment of an agent, whose business it is to attend markets and buy and sell for others. These men are generally called salesmen or factors; and when their character for honesty is established, the small sum which is paid them on the sales will generally be found to be fully compensated by the advantage which their knowledge of the markets and of the quality of the articles gives them. This is particularly the case in the buying and selling of live stock, which requires much more knowledge and experience than most other articles. The people whom the farmer has to deal with in fairs and markets have generally a thorough knowledge of the real value of the articles offered for sale, by constantly frequenting markets, and confining their attention to buying and selling only. The farmer is therefore seldom a match for the dealer, and will find it his interest to employ a person equally skilled in these matters. The farmer would lose too much valuable time, and be led to unnecessary expense, if he attempted to obtain the requisite knowledge, by frequenting different and distant markets, as the dealers do.

Notwithstanding this, a certain knowledge of markets and prices is necessary to enable a farmer to detect imposition or ignorance in the person he employs; and the occasional attendance at fairs and markets is indispensable to obtain this knowledge.

When the whole bulk of the articles to be sold is brought into the market and exposed for sale, the market is called a *pitched* market; when only a small portion is brought, to show the quality of the whole, it is called a *sample* market. Each has its peculiar advantages and inconveniences. In a pitched market the buyer sees what he purchases, and can thoroughly examine it; he may therefore be induced to offer a more liberal price. But it often happens that he has to carry a load away by the same road by which it was brought; the sacks also have to be returned, which causes frequent mistakes and losses; and there is an evident waste of time and labour. When the article is sold by sample, there is more reliance on the honesty of the seller, and the buyer naturally keeps on the safe side, by offering somewhat less, as a kind of insurance against slight deceptions. The buyer keeps half the sample and the seller the other, that they may be compared with the bulk in case of any dispute. The seller sends the article sold on a day agreed upon; and if it is corn, the sacks are brought back when the waggon or cart returns home. The price is usually paid on the next market-day. In very large dealings the selling by sample is generally adopted; small quantities are usually pitched.

Great inconvenience arose formerly from the various measures used in different markets; and dealers required tables to reduce them to one standard. The law which has established one uniform standard of weights and measures has removed all difficulty; and the rapid and frequent communications which now take place between the great towns and every inhabited spot in the kingdom have made prices much more nearly alike, for all articles of general necessity in all parts of Great Britain, than in any other country; and the prices in the markets of the great towns differ so little, that in the country these are generally regulated by those of London, Liverpool, or Edinburgh. Every farmer who cultivates land to any extent must attend to the fluctuations of the markets, and his operations may be much influenced by the comparative prices of different kinds of grain.

MARL, an earthy substance found at various depths under the soil, and extensively used for the improvement of land. It consists of calcareous and argillaceous earth in various proportions, and as the former or the latter prevails, so it is beneficially employed on clays or sands. There are several distinct sorts of marl—clay marl, shell marl, slate marl, and stone marl. The clay marl has probably been formed by the slow deposition of clay suspended in water and mixed with the particles of decomposed shells. When these shells have retained their form, or appear in fragments in the marl, it is called *shell marl*. A considerable compression and a complete decomposition of the shells form slate marl and stone marl. The effect of marl is the same as that of clay and chalk upon sandy soils; on heavy soils its effect is proportioned to the quantity of calcareous earth which it contains. The peculiar advantage of marl is its readily crumbling to powder by the effect of air and moisture. If it is too compact to dissolve under these influences, it can only be made useful by burning, and in this case it is only a substitute for lime, its value depending on the proportion of calcareous earth in the marl. To ascertain this proportion, the marl is thoroughly dried over the fire and pulverized; a certain quantity is weighed and put into a cup; diluted nitric acid or strong vinegar is poured slowly upon it, out of a vessel containing a known quantity, until all effervescence ceases. A quantity of the acid equal to that which has been used is placed in a cup, and fine marble dust is gradually put into this, from a certain quantity which has been weighed, as long as any effervescence appears. The weight of the marble dust used for this purpose evidently gives the quantity of calcareous earth in the marl, since it takes the same quantity of acid to dissolve it.

Marl is often found very near the surface, so as to mix with the soil in ploughing; but unless there be a sufficient depth of soil above, its presence does not indicate great fertility. It is generally best when found at a moderate depth, so as to be readily dug out and carted on the adjacent lands. In Norfolk, where a marl containing a large proportion of clay is found in many places under a light soil, it is frequently spread over the surface at the rate of two or three hundred cart-loads per acre. This dressing, joined to under-draining, makes a wonderful improvement on soils which before were scarcely worth cultivating, owing to their being loose and wet in winter. The clay marl makes them retain sufficient moisture, while the superfluous water is carried off by the drains.

Marl being often found with blue veins through it, a marbled earth containing sulphate of iron, or vitriol, has sometimes been mistaken for it; but this, far from being useful, is quite the reverse, for sulphate of iron in any quantities will produce absolute sterility in a soil. The nature of marl can always be detected by pouring a little vinegar on it; if it does not effervesce, it is only clay, and probably contains iron, which is readily discovered by the red colour on burning a portion in the fire, or by mixing it with water and then adding an infusion of gall-nuts in the strained liquor: the black colour immediately detects the sulphate of iron.

Marl when put fresh upon the land requires some time in order to become effective. It should therefore be laid on the surface and spread before winter, leaving it there for a considerable time before it is ploughed in. It is most advantageous to put it on the land when it is in grass, and to roll and harrow it repeatedly, in order to expose it to the effect of the air and rains. Alternate frosts and thaws greatly assist its pulverization.

Too much marl may be put upon land, and it is better to repeat the marling after a few years than to put on a great quantity at once. The proper dose depends on the nature of the soil and that of the marl. Sand will take a very large quantity of clay marl; but even shell marl should be put cautiously on clay soils; they may not always be improved by a great addition of calcareous matter. There is no greater mistake than to imagine that marl is a substitute for dung. Light land which has been marled becomes less hungry, and marl will make dung go further, but it will not act well on a poor soil without dung; and if the land is severely cropped after marling, and not sufficiently recruited with enriching manures, it will be sooner exhausted than if it had not been marled; for marl, like lime, renders soluble the natural humus in the soil.

It is very easy to judge of the value of any marl on a given soil when the proportion of calcareous earth and clay in its composition has been ascertained. We have only to consider what improvement will be produced in the texture by the addition of so much lime and so much clay. The advantage of marl over pure chalk is only that it is more readily pulverized; but wherever chalk can be had at an equal expense, it is far more effectual and of longer duration on clay soil than the best marl. On sands it may be different, and the fat marls containing much unctuous clay are preferable from their binding nature.

An excellent use of marl is in forming composts with dung and peat earth. It is laid in layers with the dung and peat, and if the heap is well soaked with urine or the washings of stable-yards, it will in a short time become a most valuable manure for all kinds of soils. Many peat-bogs are formed on a marly bottom; where this is the case, and it can be drained, or the water got rid of in any way, the marl, when laid on the surface, consolidates the peat by its pressure, and soon makes it capable of producing good herbage by converting it into a rich vegetable mould.

The expense of marling land can only be calculated when the distance of the marl and the depth from which it is raised are known; when it lies in a substratum under the land, it is generally the cheapest plan to open a pit in each field; for the carriage of the marl is the chief expense. Within a distance of two hundred yards from the pit, it is found by experience that the cheapest way of putting it on the land is by means of men wheeling it in barrows with the help of planks, as is done in digging canals and other similar public works.

MAY-WEED (*Anthemis arvensis*, or Wild Chamomile), a troublesome weed in corn, which is difficult to eradicate, as it is propagated both by seed and by the low running branches which strike into the soil and take root. It flowers in May, as its name denotes, and sheds its seed long before the corn is reaped. The only certain mode of extirpating it is by great care in clearing the land when it is fallowed or prepared for turnips, ploughing it in as soon as the flowers appear, and never allowing it to go to seed. In the alternate system it is soon got rid of by the hoeing of the green crops; clover also kills it when the land is in good heart, and in the convertible husbandry it is destroyed while the land is in grass, and mown. It is a sure sign of a slovenly husbandry when the land is covered with May-weed. It often infests farms which have been neglected by out-going tenants, and it is indispensable to get rid of it before any attempt at improvement is made. A good clean fallow is the surest means of destroying this as well as all other annuals: by repeated harrowings the seeds are first brought to the surface, where they vegetate, and are afterwards destroyed. The time to do this is in dry weather interspersed with occasional showers, as in the months of April, May, and June.

MEADOWS are properly low grounds on the banks of rivers, which, being kept moist by their situation, and also occasionally flooded by the rise of the waters, are best adapted for the growth of grass, and are generally mown for hay. Some meadows of great extent, belonging to a community or district, in which every inhabitant has a right to send his cattle to graze, under certain regulations, are never mown.

When the number of those who have a right of common pasture is not very great, they frequently agree among themselves to abstain from depasturing the meadows in spring, and, dividing them into portions, each makes hay of his share; after which the cattle are admitted in common for the remainder of the season. Thus a common meadow is converted into a *Lammas meadow*, that is, a meadow which becomes a common pasture after the 1st of August, this being the time when it is supposed that all the hay has been made and secured.

When meadows are private property they become much more valuable. The flooding is encouraged or prevented according to circumstances, and in many cases artificial irrigation is adopted. [IRRIGATION.] If they are exposed to be too often inundated, they are protected by dams and sluices.

The herbage of low wet meadows is generally coarser and less nutritious than that of those which lie higher: hence upland hay, as it is called, is preferred for the better sort of cattle. Good grass land, to which the floods never rise, is often called meadow land when the natural herbage is permanent, and frequently made into hay.

Upland meadows are very valuable wherever there is a demand for good hay. A considerable degree of attention is required to make them most productive. Not being annually recruited by flooding, they would soon degenerate if some pains were not taken to keep up their natural fertility. This may be done in various ways: the most obvious is to recruit them frequently with the richest animal and vegetable manure, which, being spread over the surface at a time when showers are abundant, that is, either early in spring or immediately after midsummer, is washed down to the roots of the grass. A rapid growth is thus produced, which is soon perceived by comparing the appearance of a meadow which has been manured with that of one left in its natural state. It has been asserted by many agricultural authors that the produce of hay is greater when the meadows are mown every year, provided they be occasionally manured, than when mown and depastured alternately. But the productiveness of a meadow depends entirely on the circumstances of soil and situation. A meadow, the soil of which is naturally of a rich nature, and adapted to produce fine grasses, may be mown year after year without any perceptible change in the quality of the hay; while another of inferior quality requires to be occasionally cropped close, to check the growth of the coarser grasses, and to allow the finer to rise. As to the effect of taking off the hay by mowing it, compared with that of the bite of cattle, there is little difference, except that in pasturing the grass is repeatedly cropped close to the ground as soon as it rises to such a height that the teeth of the cattle can sever it. It consequently spreads by the roots, and the pile becomes closer.

The urine of the cattle greaty promotes luxuriant vegetation in rainy weather, but in hot dry weather it does more harm than good. The dung, when dropped on the grass, is of little or no value compared with what it would be if mixed up with straw, earth, or peat, or diffused through water in a tank. It is therefore an excellent practice to employ women and children to collect the fresh dung in the pastures, and to carry it to a heap of earth, where it may be covered up, or to a tank, where it may be diluted with water.

Of late years the practice of *soiling* has been extensively adopted; that is, all the grass is mown and carried every day in a green state, to cows or horses tied up in a stable. By this means all the advantage of mowing for hay is obtained, besides an abundant supply of rich manure, which can be applied to the land in a liquid and diluted state, when its effect is powerful and certain. So much more fodder is produced from the land by the system of soiling, that arable fields are converted into artificial and temporary meadows, in which the different species of grasses are sown, in order to be cut green or made into hay; and when, from the nature of the soil, the herbage degenerates, the field is ploughed up again, greatly improved by this change of cultivation. [GRASS LAND.]

When a natural meadow has been neglected, and the grass is of an inferior quality, and mixed with rank weeds and moss, it requires much care to restore it to its original fertility. In most cases the shortest method and the best is to plough it up, clean and manure it during a course of tillage, without taking very exhausting crops from it, and then to lay it down again in a clean and enriched state, by sowing the best sort of grass seeds; or, which is preferable, by inoculating, or planting in it small tufts of grass from some rich meadow, which will soon increase, and produce a new and improved sward. But where the soil is a very stiff clay, with only a small depth of good mould over it, there is some danger in breaking the old sward, for it will take a long time and much manure to reproduce a proper covering of grass. In this case it is a preferable practice to scarify the meadow, by means of instruments which do not go deep, but only tear up the surface. If this is done early in spring, when the ground is moist, and the whole surface is brought to resemble a fallow field, good grass seeds may be immediately sown. If rich manure, mixed with lime or chalk, is then spread over the land, and the whole well harrowed and rolled, the old and young grass will spring up together, and show a wonderful improvement in a very few months. It is prudent to mow this renovated meadow before the seeds of the grasses are formed, contrary to a common notion that in a thin meadow the seed should be allowed to shed, in order to increase the number of plants. The notion is good, but it should be done by sowing seed which has been produced on other ground: for the ripening of the seed tends to exhaust the soil. If the grass be cut before the flower is faded, the roots will soon spread, and produce a new and improved sward.

It must be observed that it is not indifferent what cattle are turned into the meadow after hay-making. Horses invariably produce coarse weeds by their dung and urine ; cows may be depastured in autumn, as long as the surface is dry ; but sheep are far more advantageous, and may be kept in the meadows at all times, if they are not too wet for the health of the sheep, and if there is no danger of their having the rot. As soon as the surface becomes soft by the autumnal rains, all heavy cattle should be excluded: every tread of a horse or cow at this time destroys a portion of good grass, and makes a hollow, in which the water remains, killing the finer grasses, and producing rushes and aquatic plants.

The meadows which are to be mown should be shut up early in spring, and those which are soft and wet should have nothing larger than a sheep in them from November till after hay-making time the next year.

MELILOT, the Melilotus or Honey-lotus of botanists, so called from its smell, is a tall yellow-flowered annual. It has loose racemes of small flowers formed like those of Clover, of which it was once regarded as a species. The Melilotus officinalis, or *Trifolium Melilotus officinalis* of Linnæus, has long roots and a branching stem two or three feet high. It grows wild in woods, hedges, and neglected fields. When cultivated in a dry soil and made into hay, it has a powerful aromatic smell, and mixed in a small proportion with meadow-hay, gives it an agreeable flavour. This plant is used in making the Swiss cheese called Schabzieger. It is ground in a mill, and mixed with the curd into a kind of paste, which is put into conical moulds and there dried. [CHEESE.]

The white or Siberian melilot rises several feet high, with a strong branching stem. It was strongly recommended by Thouin in a memoir addressed to the Agricultural Society of Paris in 1788, and has been tried occasionally with some success by various agriculturists, without however having been so generally adopted for cultivation as might have been expected from the high encomiums passed upon it. It will bear four cuttings in the year, and produces a very great quantity of green fodder. It should be cut before the stems become woody, and thus it will continue several years in the ground, although it is naturally only biennial. A light and moist soil suits this plant best.

MIDDLESEX AGRICULTURE.—The soil of this county is of three distinct qualities: poor sand and gravel on the tops of some of the hills and in various spots in the plain ; a heavy poor clay in the north and north-west portion, which is chiefly covered with permanent grass, enriched by repeated application of manure ; and a good fertile loam over a bed of gravel, and sometimes of peat, along the plain in which the Thames flows. To these must be added some rich deposits from the Thames, of a lighter and more muddy nature, which are admirably adapted for garden-ground, and have been almost entirely converted into a rich black vegetable mould, by an abundant application of dung, from time immemorial.

The surface, with the exception of a few hills on the northern side of London, none of which rise more than 400 feet above the Thames, may be described as a plain, almost perfectly level as it approaches the Thames, but with a sufficient fall for the waters to prevent any of it being marshy. The Thames has been long kept within its present channel by artificial embankments, wherever these were necessary. But it is evident that, in times beyond memory, it frequently changed its bed, which accounts for the irregular deposition of gravel in various places, and the uniform covering of loam which is found above it.

Nearly the whole of the county lies over the blue clay, which is known by the name of the London clay: and the hills which rise above it are formed of a basis of clay covered by a poor ferruginous sand and gravel. In various places the clay appears near the surface at a level considerably above the loamy deposit mentioned above.

The stiff clay is altogether unfit for arable cultivation, until its nature is altered and corrected by the addition of chalk, lime, and ashes; most of it therefore remains undisturbed by the plough. When the commons, which are now mostly enclosed, remain open, the grass was poor and of little value; but that part which has been long enclosed has a coat of rich mould over it, caused by the annual application of dung to produce a sufficient crop of grass to make hay of, and its fertility is so much increased as to afford two good crops every year. Hay-making is nowhere better understood than in Middlesex. The value of hay so near the metropolis, and the abundant supply of labourers, enable the occupiers of grass-land to take advantage of a few days of fine weather to secure their hay. The mode of proceeding, as it is given in the Report of the Agriculture of Middlesex, by Middleton, has generally been held out as a pattern to all farmers. It is no doubt excellent where labourers are plentiful, but would be attended with some risk where the number is limited, and the extent of grass to be mown is considerable. The principle is, to expose the grass as much as possible to the sun and wind by keeping it constantly shaken up and moved, which is much facilitated by the use of the hay-making machine. It may thus be carried in a very few days, and stacked in a dry state; and when it is cut out, it appears of a fine green colour, not much changed by heating. The hay-ricks are generally large and neatly finished, the sides being pulled and trimmed smooth, and the top well thatched with straw. When the old hay is carried to market, it is tied up in neat trusses weighing 56 lbs. each, and 36 such trusses make a load. The trusses of new hay are made of 60 lbs. weight. It is called old when it has been in the rick three months. Some enclosures of pasture-land are made profitable by taking in horses to graze when they require rest and green food after having been overworked; but for this purpose the marsh pastures bordering on Essex along the Thames are preferred. There the soil is naturally rich, and requires little manure to recruit it.

The arable portion of the county lies chiefly towards Buckinghamshire, and between the Great Western Railway and the Thames. Some extremely good loams of considerable depth on a bed of flinty gravel, well adapted to every kind of agricultural produce, occur in several places. The lighter portions are mostly laid out in orchards, market-gardens, and nursery-grounds. Almost the whole of the land in the parishes of Chelsea, Hammersmith, Chiswick, Isleworth, and Brentford is taken up by such gardens. Here the spade is the principal instrument of cultivation. [GARDEN HUSBANDRY.]

Beyond Hounslow, including what was formerly Hounslow Heath, the land is cultivated more extensively, by farmers properly so called; and some of these occupy from 200 to 1500 acres. Here every improvement in the management of the soil is readily adopted; the best implements are in use: and it only requires a view of the fields along the two great branches of the western road to perceive that the land is kept clean and that the crops are good. The system is greatly modified by the short distance from an inexhaustible source of manure. It is not necessary to keep many head of cattle or great flocks of sheep to produce manure for the land. A smaller portion of the farm is devoted to raise food for cattle. Roots are disposed of to cow-keepers in London; but the expense of carriage is a great drawback to the profit. The produce is generally conveyed in waggons with four horses, or in tumbrils with two or three. A man and a boy are required in either case. Light single-horse carts, such as are used in Scotland, would be more economical, if one man could take charge of several carts, as is usually done there, and also in France; but the great traffic on the roads near London renders this very dangerous, and the law prohibits it. Every waggon with four horses, a man, and a boy, costs the proprietor from 1*l.* to 1*l.* 5*s.* for every working day. If half of this be placed to the account of the load taken to London, and the other half to that of the manure brought back, it will appear that, however convenient it may be to be able to procure manure at any time, and in any quantity, it is not so cheaply obtained as might appear at first sight. The number of horses required for a Middlesex farmer is much greater than where the land lies at a greater distance from any large town. The stable-dung is brought in a very fresh and loose state; it is put together in large heaps, where it heats very soon, and is then turned over, and sometimes covered with earth or sods. By the time it is carried upon the land it will have cost the farmer not much less than 1*l.* per waggon-load of three tons. Upon the lighter loams, which are improved by the treading of sheep, it is probably more advantageous to raise turnips, and fold the sheep on them, than to sell the turnips and buy town manure.

The course of crops on the farms in Middlesex is not so regular as in many other counties; but the alternation of white and green crops is very generally adopted. Naked fallows are almost entirely disused, even on the heavier soils. The land is kept clean by tares cut green, peas gathered in the pod, beans, and similar crops, which allow of ploughing and cleansing the land in summer, and sowing roots afterwards. The crops are usually drilled and well hoed: the principal are barley, clover, wheat, beans, oats,—often in this order. Turnips and mangel-wurzel are not so extensively cultivated as they are where manure must be made on the farm. A succession of tares, to cut green for the horses, is indispensable; some of these are occasionally taken to London early in the season, and sell well in small quantities tied up in bundles. Potatoes are not planted to so great an extent as might be supposed, considering the great consumption of this root in London: the reason is, that the market is fully supplied by cargoes which come by sea from Scotland, Yorkshire, Devonshire, and Jersey, where labour is cheaper and the land does not pay so high a rent. Potatoes consume much manure, whatever may have been pretended by some; and the corn which comes after them is generally weaker and less productive. When the rent of good land in Middlesex is taken into consideration, the carriage of manure, and the bulk of the crop to be carried to market by land, it will be found that, however valuable may be the produce of an acre of potatoes well cultivated, the expense is so great that the net return is little more than that of wheat, beans, or clover. It is very seldom that potatoes are planted as a substitute for the old fallow. Beans or peas in wide rows, and carefully hoed, are much preferable. Cole or rape is frequently sown on stiff loams, instead of turnips, and fed off with sheep. If the rape is drilled and hoed, it will clean the land, and forms an excellent preparation for wheat. It should have plenty of manure, which will be decomposed and well mixed with the soil when the wheat is sown. Thus the latter crop cannot fail to be good.

The grass-land is everywhere well managed. The surface is kept intersected with water-furrows wherever the soil is impervious to water, so that it never stagnates in winter. The grass is generally cut twice in the season, and made into hay; but the land is well manured, generally after the first mowing, about the middle of June. The Midsummer rains wash it in, and the aftermath is much increased by it. Two tons of hay at the first mowing, and one ton at the second, may be considered as the average produce of a statute acre. The rent of grass-land about ten miles from London, including rates and tithe, averages from 4*l.* to 6*l.* per acre. Nearer London grass-land lets very high for milch cows, and likewise for pleasure horses to graze in. But the rapid increase of buildings has converted so many fields into streets, or broken up the surface for the sake of the brick-earth, that the green meadows are every year farther from the centre of the metropolis.

Every breed of animal is to be met with in Middlesex. Horses and milch cows are the most common, as the most useful. The cart-horses are generally fine and strong. Some large horses, a little too heavy for a carriage and too slow for stage-coaches, but which make excellent cart-horses, are brought to London in large quantities by dealers, who collect them in the northern and midland counties. The dairy cows are chiefly of the large Holderness breed or the short-horn. Ayrshire cows have been tried, and, as far as milk goes, they are fully equal to the other breeds, taking the quantity of food consumed by each into consideration; but they do not yield such heavy carcasses to the butcher when fatted off. The most approved system of London dairymen is to let a cow be milked till she goes dry, and never allow her to go to the bull. By very high feeding she will increase in flesh while she gives milk, and by the time she is dry will be very fat. Private families in the neighbourhood of London, who have grass-land, have a predilection for the small Alderney cows, which give a small quantity of extremely rich milk. They are very quiet animals, and may be tethered or led about to graze in a halter. On good pasture they are very profitable. Alderney dairies have been established; but most of them have no title to that name, the large cows having soon superseded the smaller.

The price of labour in Middlesex is not so high, when compared with that of the adjoining counties, as might be expected. Very near London market-gardeners pay their labourers from 15*s.* to 1*l.* per week for day-labour; but as much as possible is done by the task. Digging and trenching are done by the square perch, the price varying according to the soil and the depth of the work. A good workman will earn 3*s.* 6*d.* or more in a day, but for this he must work hard. A mower has from 3*s.* to 6*s.* per acre for mowing grass, 2*s.* 6*d.* to 3*s.* 6*d.* for clover, and the same for oats or barley; tares and peas are hooked at from 3*s.* to 5*s.* per acre; wheat and rye are fagged, that is, cut close to the ground with a large reaping-hook, from 10*s.* to 18*s.* per acre, as the crop may be more or less heavy; beans for 6*s.* to 9*s.*; thrashing wheat costs 4*s.* to 5*s.* per quarter, and 1*s.* per load for tying up the straw; oats are thrashed for 2*s.* or 2*s.* 6*d.*; beans and peas, 1*s.* 6*d.* to 2*s.*; hay is cut, trussed, and every truss weighed, for 2*s.* 6*d.* to 3*s.* the load of thirty-six trusses; turnips hoed, first time, 6*s.* or 7*s.*; second time, 5*s.* Women making hay, and gathering peas or fruit, earn about 1*s.* per day.

These were the prices about thirty years ago; they had increased with the price of corn and meat, but have again fallen. At this moment they are rather on the increase; yet the above prices may be relied upon as fair averages in a circle of twenty-five miles round London. The principal weekly markets in Middlesex, out of London, are Barnet, every Monday; Southall and Finchley, on Wednesday; Uxbridge, Brentford, Hounslow, and Edgware, on Thursday; Staines, on Friday; and Enfield on Saturday. Uxbridge is a great corn-market; Southall chiefly for cattle and sheep; those which remain unsold are sent to Smithfield on the Friday. Staines is also a good corn-market.

MOOR, a name given to extensive wastes which are covered with heath, and the soil of which consists of poor light earth, mixed generally with a considerable portion of peat. The want of fertility in moors arises chiefly from a deficiency or superabundance of moisture, the subsoil being either too porous to retain it, or too impervious to allow it to escape. Both extremes occur in some moors, which are parched up in dry weather, and converted into a dark mud by any continuance of rain. A considerable portion of iron in a state of hydrate is also generally found in the soil of moors, which is very hurtful to the vegetation of plants, except heath, furze, and other coarse plants, which almost entirely cover the moors. This iron is carried down through the light surface-soil, and, if it meets with a less porous earth below, is frequently deposited in a thin layer, cementing the particles of silicious sand, which are carried down with it, and forming what is called the *heath-pan* or *moor-band.* This substance is perfectly impervious to water, and wherever it exists in a continuous state, all attempts at improvement are vain, till it is broken through or removed. The roots of trees occasionally find a passage through interstices or fractures of the pan, and then often grow luxuriantly. But wherever young trees are planted, without the precaution of breaking through the moorland, they invariably fail, and disappoint the expectations of the planter, who, seeing fine large trees growing around, naturally imagined that the soil was peculiarly fitted for them. If the stump of a large tree, which has been cut down, is grubbed up, pieces of the moor-band may often be seen all around the stem, at a short depth below the surface, so arranged as to show evidently that the tap-root, having found an aperture, and extending its fibres downwards into a better soil, has, in swelling, broken the pan and pushed it aside. When the moor consists of a loose peaty earth of little depth incumbent on a rock, as is the case in many mountainous countries, no art can fertilise it. In dry weather the whole surface has the appearance of a brown powder like snuff, which becomes a spongy peat as soon as it is soaked with rain. The hardiest heaths and mosses alone can bear this alternation; and where the substratum of rock is not broken into crevices through which the roots penetrate, all vegetation ceases except mosses and lichens.

In the valleys, where the waters have brought various earths mixed with decayed vegetable matter from the surrounding hills, the substance deposited is mostly peat, which is useful as fuel in proportion to the quantity of bitumen and carbon which it contains. When the peaty matter is mixed with a considerable portion of clay and sand, forming a peaty loam, and a convenient outlet can be found for the superabundant water, it is very capable of improvement, chiefly by draining, burning, and liming. [BARREN LAND.] As soon as the heath is destroyed by burning it together with a portion of the surface, and the peat-bog has acquired a certain consistency by draining, the application of hot lime will enable it to produce potatoes and oats, and the peaty matter will soon be converted into a rich soil, abounding in humus, and requiring only repeated cultivation to become extremely fertile. [PEAT.] Much judgment is required to know whether a considerable capital may be safely laid out in the improvement of moors. In some cases the return is certain and very considerable; in others the capital is entirely thrown away. Sometimes extensive moors have been converted into flourishing farms of arable and grass land, as in many parts of Scotland and the north of England; sometimes they have been most advantageously planted with forest-trees, and, where there is a great extent of waste and a scanty population, this is generally the most certain mode of improving a property, although the return is slow and distant.

A prudent proprietor, before he begins expensive improvements, will do well to have his wastes carefully examined by a good surveyor. The soil and subsoil, and the situation of the springs, should be carefully ascertained by boring in different places to the depth of five or six feet. It will thus appear whether any portion can be readily converted into arable land, or improved as pasture, or whether plantations of trees may be safely made. The division of the waste into fields by deep ditches will often be sufficient to lay them dry; if not, recourse must be had to draining. In the humid climate of Great Britain and Ireland, the water which falls in rains in the winter half of the year is always more than is necessary for healthy vegetation, and ditches are generally indispensable to keep the surface dry. The convenience of enclosures for pasturing cattle and sheep to advantage, added to this, has made the division of wastes by ditches and banks an invariable preliminary to cultivation. Expensive draining may not always be expedient, where the soil is naturally poor; but wherever there is sufficient loam, either immediately under the peat or mixed with it, and lime can be obtained at a moderate cost, the soil may always be brought into cultivation, and will fully repay any judicious outlay of capital.

In many situations on the slopes of hills, or in the valleys, good earth may be found at a moderate depth, which, being carted on the moor, will materially improve the surface. It should be carted out in the beginning of winter, and spread over the surface an inch or two deep. It should be left so a considerable time, especially if there is any appearance of ochre or iron in the earth. The exposure to the air and rain will convert the hydrate or carbonate of iron into an oxide, and thus render it innoxious. The earth also will absorb fertilising portions of the atmosphere, and be much improved. It may then be ploughed in with a shallow furrow, and incorporated with the natural soil by harrowing. A small quantity of lime and manure will bring this mixture into a productive state.

There are many moors which, although incapable of profitable improvement as arable land, may, at a comparatively small expense, be much improved as pasture for sheep and cattle. The principal means of effecting this are, judicious draining by ditches, and enclosing the fields with banks or stone walls, both as shelter for the stock and convenience of feeding. The heath may be burnt and the ashes spread about, and the surface having been scarified to the depth of a few inches, some grass-seeds suited to the soil and climate may be sown. The surface will soon show a manifest change by the increase of green patches, and a subsequent liming will complete the improvement. When the health of the stock, as well the increase of food, is taken into the account, it will be found that such an improvement of moor-land soon repays the outlay.

When the surface of the ground is very uneven, with protruding rocks, interspersed with large stones, the only improvement which can be undertaken is to plant trees, chiefly of the fir or pine tribe, which will grow well if put in judiciously. The plants should be of the last year only, and the ground where they are to be planted should be well examined to find out whether there is a moor-band or rock below. The first must be broken through, which may be done by trenching or by means of heavy-pointed iron bars thrust into the ground with considerable force, wherever a plant is put in. If there is a rock below with six inches of earth over it, provided it be not of a very compact and solid nature, the fir-trees will grow rapidly, and the roots will find crevices to strike into. A plantation should begin in a sheltered spot, and it may be enlarged every year towards the more exposed side. Thus even the highest and bleakest hills may in time be covered with wood, and, if properly managed, cannot fail to be profitable.

Moss-land is often confounded with moor; but it is very distinct in its nature. Moss-land is produced by the accumulation of aquatic plants, and its origin is chiefly vegetable. When it has a considerable depth, and its substance has lost all power of vegetation, it forms peat-bogs of more or less consistency, as the water is drained off or retained in its pores. In the latter case it appears like a spongy vegetable mass, consisting almost entirely of fibres, so interwoven as to form a very light substance, in which water is easily retained, which keeps up a kind of internal vegetation, by which the quantity of the moss is gradually increased. This is the substance which covers the surface of bogs, and where it is of some consistence it allows a passage over them [Bog]; but where it is very thin and loose it deceives the eye by an appearance of solidity, like that of a smooth green pasture, which however gives way to the pressure of the foot, and allows it to sink through it with very little resistance. The only way to improve moss is to drain it, and then convert the vegetable matter of which it is composed into soil, by means of lime and pressure. The latter is effected by putting on a considerable quantity of earth, especially sand and gravel, which, incorporating with the moss, consolidates it, and assists the lime in decomposing the vegetable fibre. After this it becomes extremely fertile, producing abundant crops of potatoes and oats; and whenever it has acquired sufficient solidity by the treading of sheep and cattle, it will produce good crops of wheat, or, if laid down to grass, give abundance of hay and pasture. Trees do not thrive in mossy soil, there being too little solidity for the roots, and the large trunks which are frequently found in bogs must have grown before the moss was formed. This may be easily imagined. A wood laid flat by a storm or hurricane may obstruct the natural flow of the waters, and cause them to accumulate. The prostrate trees become surrounded by aquatic plants, which spread their fibres and roots freely through the water, and, decaying, make room for others. Thus the trees are gradually covered and buried in the moss till future generations find them, when the moss or bog is explored for fuel or for improvement. The trees which are found buried in mosses frequently show evident signs of having been gradually covered. The upper surface is often decayed and uneven, while the lower surface shows that it has remained submerged and protected from the contact and influence of the air, and has thus been preserved from rotting.

NORFOLK AGRICULTURE.—Norfolk has long been considered as foremost among the English counties in an agricultural point of view. The same causes which have made the Netherlands productive, beyond the natural capacity of the soil, have brought about similar effects in Norfolk, where the improved systems of cultivation have been adopted by imitating the Flemings, with whom a direct intercourse has always been kept up from the eastern ports of England.

The climate of Norfolk is somewhat colder than that of the southern and western counties of England. The coast is exposed to the north-east winds, and the whole of the county is nearly a continued plain, with only slight undulations of the surface. Except in a small portion of the county on its western boundary, and a strip along the southern part, which are marshy, the air is dry and healthy. It is, on the whole, as favourable to the tillage of the land and the growth of corn as any part of England.

The soil may be divided into three classes: light sands of various qualities, chiefly in the north-western part of the county; low alluvial clays and loams, on the borders of Lincolnshire and Cambridgeshire; and loams of various qualities, chiefly light, incumbent on a marly clay, in the centre and eastern part. There is a strip of peat and marsh along the southern boundary, where the Ouse and the Waveney take their rise, and run with a very slow current, the one towards the west, where it discharges itself into the Wash, and the other eastward to the sea at Yarmouth. At Lophamford, where there was formerly a gate dividing Norfolk from Suffolk, the water runs to the right and left of the road: and from this point, which is low in appearance, the two rivers begin to flow. The fall from this point to the sea, on both sides, is very trifling, and the whole course lies in low peaty marshes.

The district in which the true Norfolk system of cultivation was first adopted, and where turnips and clover were introduced in the regular rotations, was that on the north-west, where the better kinds of sand prevail. From this district it has gradually spread; and there are now few soils in Norfolk which are considered too heavy to bear turnips, especially after having been well underdrained—a practice which evidently arose from the desire of raising turnips to feed cattle and sheep, and manure the land.

It is now more than a century since the system of cultivation which bears its name has been almost universally adopted in this county. It was the necessary consequence of the introduction of turnips in the place of the old fallow; and has only been modified by substituting artificial grasses, peas, or tares, for the clover, which was found not to succeed when too often repeated on the same land. In the regular course of turnips, barley, clover, and wheat, only one-fourth of the land is in wheat; but in very good loams, and where manure is abundant, it may safely be sown at a less interval than four years, by introducing peas or beans after the first rotation, and taking a crop of wheat after them. Thus the rotation becomes one of six years, viz. turnips, barley, clover, wheat, beans, and wheat. There is another advantage in this, that the clover only recurs every sixth year, and its success is more certain. Where the soil is poorer, and manure could not be produced in sufficient quantity to keep up the fertility, the artificial grasses may be allowed to remain two or three years for pasture, which recruits the land and saves manure. These circumstances will readily account for all the deviations from the original four years' rotation.

Norfolk was for many years far before other counties, north or south of it, in its agriculture; but for thirty or forty years little or no progress was made; and the Norfolk husbandry, introduced into the north of England and south of Scotland, advanced more rapidly than in the county where it originated. Turnips, having been originally introduced from Flanders and Holland, still continue to be sown broad-cast, as they are there. The raising them on ridges in rows, which is so much preferable, both in respect of the crop and the improvement of the soil, is only adopted by gentlemen and those farmers who have risen above the prejudices attached to a long established practice. Although the drilling and dibbling [Arable Land] of wheat have been almost universally adopted, the turnips are still growing irregularly at various distances, a circumstance which precludes the use of the plough in the intervals, and restricts the cultivation to that of the hoe. Hence Norfolk does not in general produce such heavy crops of turnips as similar soils in Northumberland or in Scotland.

The crop which is raised in the greatest perfection in Norfolk is barley. It may be considered as the most important portion of its agricultural produce: and where sheep have been folded on turnips, and the surface is enriched by their dung and consolidated by their tread, a slight shallow ploughing makes a perfect preparation for the seed. The old practice in Norfolk was to work the land by ploughing it three or four times for barley after turnips and for wheat after clover, as may be seen by Arthur Young's 'Report' of that county. Young justly condemns this practice on a light porous soil. Since that time a better practice has been introduced, and much useless ploughing has been omitted. On the heavy loams repeated ploughing may be thought necessary; but to plough often early in spring, when the land has been wet for a considerable time, is less likely to pulverise a heavy soil, than to watch an opportunity and plough it at the right time, when the soil is friable and readily crumbles under the harrows. Heavy loams should only be repeatedly ploughed when the earth falls readily from the mould-board, which it does when neither too wet nor too dry. Where great attention is paid both to the quality of the grain and the quantity produced, no clover is sown amongst the barley, but it is drilled and hoed like wheat. This however is the exception, the general rule being to sow clover, after a shower, as soon as the barley appears above ground, and to slightly roll the surface.

There are few counties where such an extent of poor unproductive land has not only been brought into cultivation, but made equally productive with those which are naturally fertile, as in Norfolk. This has been effected chiefly by laying considerable portions of the marly clay, found a little below the surface, on the poorer soil which was at the surface, and by an excellent system of draining the land where the subsoil is impervious to water. The drains are made in winter, when labour is cheap, in a very simple manner; the inclination of the soil being ascertained, and the ditches deepened so as to carry off the superfluous water, main-drains are laid out to receive the water collected by the smaller branches. Thirty inches is, in general, thought a sufficient depth for a main-drain, which is only two or three inches wide at the bottom. In this are laid bushes, heath, broken stones, or, which is best, draining-tiles, according to the means of the proprietor or occupier, and the cost at which they can be obtained. Parallel drains from twenty inches to two feet deep are dug, which meet the main-drain obliquely downwards at the distance of from fifteen to thirty feet from each other, according to the wetness of the land. By this means all the surface-water, which is not held in the soil, and which is more than is required for the healthy vegetation of the crop, runs slowly into these drains, which lead it into the main-drain, and ultimately into the receiving ditch. Thus the land is kept in a sound dry state, and however impervious the subsoil, sheep may be folded upon it at all times. This draining is very different from the draining of springy or marshy soils, and requires a different system from that which Elkington practised with so much success. Any man may lay out drains judiciously, where it is only required to give an outlet for the superfluous water which falls on the surface in a rainy climate. The only thing to be attended to is to proportion the distance of the drains to the nature of the soil with respect to porosity, and to the quantity of rain which usually falls in autumn and winter. A light porous soil of some depth might be much injured by draining, however wet the climate, for if it is useful to take off superfluous water, so it is beneficial to retain it where it runs off too fast.

These are the immediate means by which the waste lands of Norfolk have been brought into a fertile state. But much is also due to the practice of granting long leases to wealthy tenants, in which practice Mr. Coke (the late Lord Leicester) led the way, and justly deserves the title of a benefactor to his country, while he received his reward in the increase of his property and the affection of his tenants. A proprietor has not always the means, and frequently not the judgment required to undertake expensive improvements; but a tenant with a lease for a term of years calculates, and lays out his money as a speculation. The benefit which he derives is justly his due, but, whatever be the result, the land is improved, and the landlord benefited in the end. Leases have invariably tended to the rapid improvement of all farms so let, when the means and character of the tenant were ascertained, and judicious clauses introduced, not to fetter the tenant, but to prevent his injuring himself as well as his landlord.

To give even an outline of the mode of cultivation usually followed by the Norfolk farmer would require considerable space. It is sufficient to observe that the principles are chiefly those of a careful garden cultivation, and that, to provide sufficient manure for the corn crops, half the land is devoted to raise food for cattle. The soil is not stirred so deep as in many other districts, which is owing to the thin staple of it in most places. The Norfolk farmer, in general, prefers a few inches of good earth made rich with manure, to a greater depth of inferior earth. Much time and expense are also saved by slight ploughing, which is performed by a very light plough, turning over a furrow ten or twelve inches wide and seldom more than four inches deep. Thus an acre and a half are prepared for sowing in one day, by a boy and two horses. This is particularly the case where turnips have been eaten by sheep folded on the land. The clover-ley and artificial grasses are likewise ploughed shallow for wheat, which is sometimes very advantageously dibbled in the sward when turned over completely; for the wheat tillers and throws up many stems, deriving its nourishment chiefly by the coronal roots. In particular seasons and situations it is often subject to mildew, which is not so much the case where the soil is cultivated to a greater depth

The chief cultivation and manuring are given in the preparation for sowing turnips, which begin the rotation. The land is ploughed and harrowed repeatedly, the weeds being collected and burnt; and finally it is ploughed in stitches, as they are called in Norfolk, which are divisions consisting of five or ten double furrows, according as the soil is heavy or light. This is done to let the surface water run off by the deeper furrows between the stitches, and for the convenience of sowing or drilling the seed regularly. The turnips are hoed by hand, and the labourers are very expert in leaving them at regular distances. A second hoeing is generally sufficient to destroy the weeds, after which the turnip-leaves so cover the ground that, if any weeds appear again, they are kept under by the shade of the turnip-tops. The turnip-fly and black caterpillar are, as elsewhere, a great torment to the farmer, especially where turnips have been long regularly sown every fourth year on the same land. Various devices have been resorted to in order to prevent the depredations of these insects, but none have had complete success. A muslin net like a bag has been drawn over the land as the turnip-plants are coming out of the ground, and thousands of flies have been caught; but they seem to be produced more rapidly than they can be taken. The most certain preventive is a high state of cultivation and abundant manuring of the land, by which the growth of the turnip is forced, and it is soon in the rough leaf, after which the danger from the fly is over. Against the black caterpillar, the only means yet found effectual is driving a large flock of poultry over the land, which devours great quantities of them. Mangel-wurzel has been cultivated by many on the better kinds of loam with various success: in some years they succeed to admiration, and in others fail entirely. There has been a fluctuation in the opinion of farmers with respect to mangel-wurzel; the majority seem now to prefer the Swedish turnip, or Ruta Baga, as more nutritious for feeding stock, and not more liable to failure, with proper attention.

The implements used in the cultivation of the soil are very various. The ploughs in common use are the small swing-plough with a single stilt or horn, evidently slightly varied from the Flemish plough, and the same plough with a more upright beam resting on a carriage with two wheels. The peculiarity of the Norfolk wheel-plough is the shortness of the beam, the wheels being very little before the coulter. This makes it much lighter in the hand, although not so steady if it meets with any obstruction; but it suits the shallow furrow which is usually turned up, and it is so easily managed, that boys twelve and fourteen years old may be seen holding one of them without any apparent exertion, unless it be at the end of the furrow, when it is turned into a new one; and even then a little practice soon enables a boy to let it slide on the edge of the turn-furrow till it enters the ground again. There is scarcely an example of a plough being drawn by more than two horses, which are yoked abreast and driven with a rein by the ploughman. The work is so light in general, that the horses work at a brisk pace; and at two yokings, of five hours each, will turn over from one acre and a half to two acres of ground. Four inches is the usual depth, and often even less. The harrows are similar to those used in other counties. The break-harrow or drag has large iron tines, which enter several inches into the ground and divide the sods and clods in the heavy loams. The small harrows are usually compounded of several separate harrows, in order to suit the convex form of the stitches, and harrow every part equally. Barley rollers are essential in the light soils; and in the stiffer loams the spiked roller is found very efficacious in bringing the soil to a fine tilth for receiving the barley and grass seeds.

Portable and fixed threshing-machines are very common, and, when well constructed, are a great convenience, if not an absolute saving, to the farmer. The labourers have foolishly attributed the want of employment, by which they were suffering some years past, to the introduction of machinery in agriculture; and many farmers have been forced to return to the old method of threshing by the flail. But hand-labour might be much more profitably employed in the improvement and preparation of the soil by dibbling, forking, hoeing, and draining; and where these operations are carried on with spirit, the labourer will never complain of being saved the laborious task of wielding the flail from morning till night.

Large barns were once thought necessary to house all the corn in; and the barley was often trod tight in the barn by horses led over it, as it was unloaded from the waggons. But no barns could now hold the produce of many of the larger farms, and stacks well thatched are found to preserve the corn better than close barns, especially when they are built on frames supported by stone, or cast-iron pillars with caps over them, to prevent the rats and mice from making lodgments in the straw. A very ingenious staddle has been invented, all of wrought-iron except the pillars, which are cast. It is cheap and portable, and can be readily moved from one spot to another, where it may be most convenient to build the stack.

On the light lands large flocks of sheep are constantly kept. The old horned and black-legged sheep, which have been in the county from time immemorial, are now in a great measure superseded by the Leicester and South down breeds. The Norfolk sheep are good, and their flesh superior to most other mutton, at a proper age; but they are great wanderers and trespassers. There are few fences which will keep them in; and since almost all the commons have been divided and enclosed, the quiet sheep are preferred. Of late the Norfolk sheep have been more noticed, and crosses of them with other breeds have been attempted with some success.

When the land is too retentive of moisture to allow sheep to be folded on it in autumn or spring, and yet good turnips may be raised in it, the usual practice in such a case is to fatten bullocks on the turnips and straw in yards or sheds. When the turnips fail before the beasts are fat, linseed cakes must be given to them, which is seldom profitable, except it be by the increase of the manure and its improved quality. When an ox can be entirely fatted from the produce of the farm, the profit is more certain than when food is purchased elsewhere. The favourite oxen of the Norfolk farmer are the small Scotch breeds, Galloway, Aberdeenshire, or West Highland. They fatten readily, are soon fit for the market, and always bring the best price, according to their weight.

There were formerly some considerable dairies in Norfolk, and butter was salted and in repute for ship store or private use; but the land is now mostly arable; sheep give less trouble and are found equally profitable; so that very few if any large dairies are to be met with. The cows kept for private use are mostly of the polled Suffolk breed, which give much and tolerably rich milk. Some cows of this breed have been known to give eight gallons of milk per day, a month after calving. There was a custom in Norfolk formerly, of letting a cow and her calf run together in a good pasture for a twelvemonth, when they both became very fat and were sold to the butcher. The yearling calf was called a *beeffin*. The flesh was tender, neither like veal nor beef, but preferred by many to either. This practice is now nearly obsolete.

Many farmers in Norfolk breed horses from their working mares; and excellent coach-horses are sometimes produced by a cross with a good bony blood-horse. Very little of the labour of the mare is lost, and that principally in summer, when the foal is very young. She is then worked slightly, but by wheat-sowing time she can do a full day's work, with proper keep, without any detriment to the foal. Thus an extra mare or two may be kept above the number of horses actually required for the farm, which will much assist the operations and expedite the tillage, while they cost but little to the farmer, as the foal will generally repay his own keep with a profit, which goes towards the keep of the mare. Some horses got by a thorough-bred horse out of an active Suffolk cart-mare have proved excellent hunters, and have been sold at high prices when five years old, having done sufficient work to pay for their keep from the time they were three years of age.

The Norfolk pigs are generally small and white, with long thin ears, differing in this from the Suffolk breed; but they are so intermixed and crossed, that no very distinct character can be ascribed to them. Those who are curious in the breed of this useful animal cross various breeds according to their fancy, and, by selecting those which fatten early and readily, they produce varieties more or less perfect. Many pigs from Suffolk and Essex, and some from Berkshire, are brought to Norfolk to feed in the stubbles after harvest, or to consume the barley which may have suffered from the weather and is not fit for malting.

Norfolk turkeys are well known as of peculiar size and delicacy. Great numbers are reared every year, and after gleaning the stubbles and having plenty of barley till near Christmas, they are sent to supply the London market. A week before Christmas many of the coaches from Norfolk are completely loaded with turkeys, and travellers are often disappointed of places.

The game with which Norfolk abounds was at one time a source of grievance to the farmer, not only in consequence of its depredations, but of the damage done to his fences by licensed and unlicensed sportsmen. The late law, which permits the sale of game, has greatly diminished the number of preserves and the quantity of game, leaving however sufficient sport for those who are satisfied with moderate slaughter.

The Norfolk farmer has numerous advantages in the disposal of the produce of his land. There are many excellent markets in every part of the county, with easy access to the coast by water-carriage, the county being nearly surrounded by the sea, and intersected by rivers and canals.

NORTHAMPTONSHIRE AGRICULTURE.—The county of Northampton has many advantages in point of climate and soil, and has for a long time been comparatively well cultivated and productive. The soil is generally adapted to produce both corn and pasture of a superior quality. A small proportion only of the surface is poor, from the thin staple of the soil or from a cold impervious subsoil; leaving out the natural woods, which are considerable, that which remains unproductive for want of cultivation is trifling, and could easily be improved. The climate is mild and healthy. The subsoil, being mostly rocky, allows all superfluous water to run down through it; and where a stratum of clay intervenes, the inequality of the surface allows a ready discharge of the water. The surface of the county, except a portion of low flat land north of Peterborough, may be, on an average, about 300 feet above the level of the sea; the greatest height does not exceed 500 feet, if we except the summits of some hills about Daventry, which may rise to the height of 800 feet above the sea.

The following elevations are from actual survey:—

	Elevation in feet.
River Ouse near Stony Stratford	200
River Nen above Northampton . .	195
Grand Junction Canal at Blisworth and Weedon	315
Grand Junction Canal at Braunston tunnel	375
Buckley road, half a mile from Daventry	430
The summit of the hills round Daventry, supposed the highest points in the county	800

Owing to its inland situation, and the absence of lofty hills, this county is not so subject to heavy and continued rains as those which lie farther west. The surface is pleasantly diversified by gentle swells and depressions interspersed with woods and plantations.

The richest soil in the county is perhaps the black mould of the fens, when they have been drained and cultivated; but the most desirable for the farmer is the brown crumbling loam of the uplands. Where this is of a sufficient depth, it will produce, with little trouble, abundant crops of wheat, beans, barley, and oats, and it is peculiarly adapted to turnips and all green crops. On such land the farmer will certainly thrive, if he does not neglect his business. The pastures are both rich and sound, and the cattle grazed in them in summer repay the capital laid out on them with good interest; while those which are kept on turnips in the yard, to be turned out in summer, or are stall-fed to bring them to a marketable state, convert the straw, which is everywhere abundant, into rich manure. These remarks indeed are only applicable to a very good soil, but they apply particularly to that hazel loam which is neither light nor heavy, which does not bake hard in drying, and, although consisting chiefly of minute particles of clay, lime, and sand, does not retain too much water.

There is a considerable portion of limestone rock in the county, but there is no appearance of chalk. The calcareous portion of the soil, which, in some rich land hastily analyzed, was found to be from 10 to 15 per cent., is in a very divided state, and must greatly influence the fertility. The heavier kinds of soil, which are more retentive of water, are found to produce excellent pasture, and are accordingly left in grass, as the most profitable for the farmer, if he is well skilled in selecting cattle to graze, and has a sufficient capital. For although more food might be produced from the land by tillage, and more hands usefully employed and fed, it is very doubtful whether the farmer would be so well remunerated for his risk, trouble, and outlay, as he is by grazing cattle. As long as the price of meat is high in comparison with that of grain, which has been the case for many years past, the grazing of the rich lands of Northamptonshire, Leicestershire, and Lincolnshire will always produce the greatest rent and profit.

The implements in use in this county have been much improved of late years. The old clumsy plough, with or without wheels, which was the only one known a century ago in the midland counties, is now replaced by a neater instrument, the principal parts of which are of iron. The Rutland plough with two unequal wheels attached to the beam, one to run in the furrow last made, and the other on the unploughed surface, is in general use. It is a plough easily held, and from some experiments lately made with great care by Mr. Handley, M.P. for Lincolnshire, it appears to be of less draught than the common swing-plough without wheels. Three horses and a driver are used even in very friable soils, and a Norfolk team of two horses abreast driven by reins in the plough is a rarity in the county.

The harrows, scarifiers, rollers, carts, and waggons have nothing peculiar in them. There are some threshing-machines on large farms, but the flail is still the principal instrument in use.

The old course of husbandry was the triennial; a clean fallow, wheat, beans, and oats on the best heavy soils, and wheat, peas, and barley on the lighter. The introduction of turnips and clover has changed the system, and greatly improved the produce. But where turnips are not suited to the soil, from its compact nature, the clean fallow, at least every fourth year, is still retained. On some lands barley or oats are sown after wheat. In the improved rotations the land is frequently left three years in grass, and then ploughed up again, which brings it to the convertible system generally adopted in the north. The most common error is that of cropping the land too often after it is broken up from grass, and reducing it to too low a state before it is recruited with manure or improved by pasturage. This error is not so injurious on very rich soils, but when the soil is of inferior quality it destroys all the advantage gained by several years' lying in grass. There is a great difference between natural inherent fertility, such as that of rich loams and alluvial deposits, and that which is produced by manuring and pasturage. The first will bear much ill usage, but the latter will not.

The permanent pastures are very good in most parts of Northamptonshire, and few landlords would permit a tenant to plough up any part of them. The extent of meadow-land of this description is reckoned in the Agricultural Report at 40,000 acres; if to this be added all that has been laid down since, and the artificial grasses raised on arable land, we shall find that 80,000 acres at least are devoted to feed cattle, without reckoning the clover and other artificial grasses mown for hay.

In old pastures, ant-hills are a great nuisance: when greatly multiplied the grass on them is of no value, and they take up much ground. The best mode of getting rid of them is to open them when frosty weather sets in, by cutting them in the form of a cross by a sharp-edged spade; the four angular pieces thus cut are separated from the ant-hill by the spade, and turned back on the adjoining grass. The earth, with all the ants and their eggs, is then dug out and spread over the ground, the grass pared off is replaced, and if this be done in rainy weather before a frost, no ants will appear in the spot thus treated, and the whole pasture may in this manner be restored to a level and equal turf.

The fattening of cattle is a principal object of the Northamptonshire farmer. Some breed their own bullocks, but this is only when they have some improved breed of their own. Earl Spencer, the Marquis of Exeter, and many others, are great breeders, and find breeding as profitable as fattening; but the majority of farmers, who have not the same advantage, prefer buying cattle reared on less valuable land, justly thinking that an animal reared on poor land and in a severer climate will thrive better and improve faster than one bred in a mild climate and a rich pasture. Hence they buy Scotch and Welch cattle in autumn, turn them into the pastures to eat the coarse grass remaining after the fat beasts are sent to market during the winter, and finish them on grass next summer. These animals improve greatly, and if they do not come to a large size, they give at least a very good profit. Some few farmers feed the Scotch cattle during the winter on turnips; but generally those who can spare turnips for this purpose buy a larger sort of cattle in the autumn. Many Hereford long-horns and Durham short-horns are bought in spring, carried on at grass till near winter, and then finished with turnips, oil-cake, and chopped straw. They make much and rich manure; and if they pay for the food which they have consumed, the farmer is satisfied. Any profit in addition to the manure is so much clear gain. The short-horn breed has of late become a favourite stock, and has almost superseded the once famous long-horns, chiefly from the example of Earl Spencer and the Marquis of Exeter, whose breeds of short-horns cannot be surpassed. At the Oxford agricultural meeting in 1839, Lord Spencer accepted a challenge which was offered by a well-known Sussex breeder, who proposed to show 100 head of Suffolk beasts against the same number of any breed. The judges, having inspected both stocks, had no hesitation in giving their award in favour of Lord Spencer's short-horns, although one of the judges was from Sussex. In fact the improved short-horned breed unites as many good qualities as can well be found in any other breed; the Hereford disputes the prize of aptitude to fatten, but the Hereford cow gives so small a quantity of milk, that all the farmers in Northamptonshire who breed cattle prefer the short-horned breed. It is yet very doubtful whether the small Scotch Highland cattle do not pay fully as well for their pasture and stall-feeding as either the Hereford long-horns or short-horns, at least on land of an average quality.

The breed of sheep most common in the rich pastures of Northamptonshire is the improved Leicester: and since long wool has been in request, and sells dearer, in proportion to the weight of the fleeces, than the finest short wool, scarcely any other breeds are in repute. The South-downs, on account of the flavour of their flesh, may dispute the pre-eminence with the Leicester breed, but no other sheep can enter into competition with the latter. Some very fine flocks of breeding ewes are kept in the county, and rams are bought, or hired for the season at very high prices, from those whose chief business is to rear the best.

There are many considerable estates in Northamptonshire, but the farms are in general not very large. They are usually let from year to year, with the understanding that the tenant shall not be removed as long as he pays a fair rent and cultivates the land properly. This is very well on estates which are in settlement, but where they are liable to be sold, the tenant has no great security, and will not lay out much capital in useful improvements, of which he may not reap the benefit.

More leases have been granted of late years, and a more improved state of cultivation has been the consequence. The farm-buildings were described by Mr. Donaldson and Mr. Pitt, in their Surveys, as by no means worthy of the fruitfulness of the soil, being inconvenient both as to architecture and situation. In this respect there is now a manifest improvement. Many excellent farm-buildings and houses have been erected; and the respectability of the tenants has increased in proportion. The very large barns formerly thought indispensable to house the crop in are now much reduced. The corn is stacked in the open air, and better preserved by a covering of thatch. Frames of wood on stone or iron pillars receive the corn, which is laid with the ears inward, and forms a round or square stack ending in a cone or pyramid, which is covered with straw and well thatched. It is thus safe from vermin, and the air circulating around and through it, the grain when threshed comes out hard and dry.

Gardens and orchards are not a remarkable feature in this county. Little or no cider is made, barley supplying the favourite beverage. The woods are extensive, and many plantations have been made in the neighbourhood of the numerous residences of the nobility and gentry. The most considerable forest is that of Rockingham, part of which has been converted into farms from time to time. These woods have been much neglected till lately, and might have been made far more productive than they have been. The pasturage of deer and cattle, and the customary rights which existed from time immemorial, have prevented the increase of timber. The navigation of the Grand Junction Canal, which brings coals to different parts of the county, has much lowered the price of underwood for fuel; and the fall in the price of oak timber since the peace has likewise diminished the value of wood.

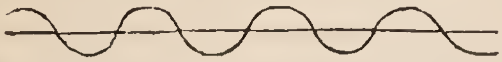
NORTHUMBERLAND AGRICULTURE. The position of this county, in the north-eastern extremity of England and along the coast of the German Ocean for upwards of sixty miles, causes the climate to be considerably colder and the harvest later than in the southern and midland counties. In that part of the county which skirts the sea-shore, although it is exposed to cold easterly winds, the air is much milder and more genial than in the western and mountainous part, which, although too high and bleak for cultivation, beyond a certain elevation, produces a sufficient herbage to maintain large flocks of hardy sheep, known by the appellation of the Cheviot breed.

Along the coast and for some miles inland the soil consists of a strong fertile clayey loam well adapted to the growth of wheat, beans, and clover, and there are some excellent natural meadows and pastures.

Along the banks of the Tyne and the Coquet, and along the Aln from Alnwick to the sea, the soil is chiefly a light gravel, sand, or dry loam, which is likewise the case to a great degree in the vales of the Beamish, Till, and Beaumont. In the middle and south-eastern parts of the county the soil is a moist loam on a cold impervious clay bottom, which is of inferior value until it has been improved by draining and careful cultivation. In its natural state it produces inferior pasture unfit for sheep, which are subject to the rot when turned out upon it, but it is better adapted for young cattle, which may be reared but not fattened on it. On the hills, which are in a state of nature, there is a mixture of low peat-bogs, stony and gravelly heaths, and some good dry green pasture well adapted for sheep feed.

The county of Northumberland has been one of the foremost of the English counties in adopting the improved system of agriculture, the chief feature of which is the cultivation of turnips for the rearing and fattening of cattle. Turnips accordingly occupy a large proportion of every farm the soil of which admits of this cultivation. So great has been the advantage derived from this change from the old triennial system, that many fields now yield heavy crops of this useful root which in most other parts of England would be considered as totally unfit for its cultivation. This has arisen from the early adoption of the culture in rows on elevated ridges, which has received the general appellation of the Northumberland method, and which we shall therefore describe with some minuteness.

The ground having been prepared by as many ploughings and harrowings as may be thought requisite to pulverise it and destroy the weeds, and laid quite flat, an experienced ploughman draws as straight a furrow as possible, and returning lays the next furrow slice upon the first, thus completing what is usually called a *bout*. The usual width of the furrow being 9 inches, the first ridge and furrow take up 18 inches; the next furrow slice being laid over the first, the whole work takes a width of 27 inches. He then enters again at the distance of 27 inches from the land side of the first-made furrow, and completes a second bout parallel to the first. When the whole field is thus laid into narrow ridges, which, from the soil being light and crumbling, gives the section of the surface a waved appearance, such as is represented in the annexed cut, the depressions are about 6 inches below the former surface, and the ridges as much above. This at once doubles the depth of the cultivated soil in the ridges. The manure is now brought on the land in small one-horse carts, the wheels of which are about 54 inches apart, so that the horse walks in one furrow while the wheels move in the two adjoining. The manure, which is chiefly common farm-yard dung, not too much decomposed, especially if the soil is inclined to clay, is laid in small heaps, drawn out of the cart by a dung-hook, or, which is better, by a boy standing on the load in the cart, who forks it out more regularly as the horse goes slowly on. It is then laid equally in the furrows by women and boys. The quantity thus laid on depends on the supply of the yard compared with the breadth of turnips intended to be sown, for the whole is expended on this crop. In general, not less than 15 or 20 single-horse loads per acre are thought necessary to produce a good crop. Twice that quantity is often put on. This dung is evenly distributed in the furrows to the right and left of that in which it has been deposited from the cart. The ploughman now begins to cover this dung by splitting the ridges in two, laying one half to the left and the other to the right, and reversing the bouts, so that the ridges are now directly over the dung, which is completely buried. The appearance of the field after this is exactly similar to what it was after the first bouting. A roller is now drawn over the ridges, to flatten them at top, in order that they may better receive the seed, which is drilled exactly on the middle of the ridge by a machine attached to the frame of the roller and dragged after it. The roller is usually sufficiently large to roll two ridges at once, and, in that case, two drilling-machines, each guided by a man, are fixed to it, and one horse, walking in the middle furrow, draws the whole apparatus forward. Thus, two men and a horse, with a boy to lead the latter, can drill four or five acres in one summer's day. The drill barrow has a very slight coulter, hollowed out at the back part to receive the tin tube through which the seed is delivered. The simplest construction of that part which distributes the seed is a tin cylinder, or rather double cone, with holes in the circumference, through which the seed falls into the tube. The seed-box revolves on an axis turned by means of a connexion with the axis of one of the wheels of the machine, which revolves with it; the other wheel turns round this axis. As long as the first-mentioned wheel goes on the ground the seed is delivered, but as soon as it is raised, so that the drill proceeds on the other wheel alone, no seed falls through, because the axis no longer turns. Thus none is lost in turning at the ends of the ridges. In very light soils another slight rolling is necessary to press in the seed; but in stiffer loams a small chain or piece of iron dragged after the coulter is sufficient to cover the seed without rolling. By this method the seed has not only a greater depth of mellow soil to strike in, but the fermentation of the dung immediately under it acts as a hot-bed and soon brings it up; by which means it generally is so rapidly in the rough leaf, that it seldom suffers from the depredations of the fly. Experience shows that in a moist climate the ridge system produces much more certain and heavier crops than could be expected in general from the most careful broad-cast culture. As soon as the turnip has four leaves out of the ground, the rows may be thinned by the hand or by the hoe, and the plants may be left from eight to ten inches apart. The next process is stirring the ground between the rows with a light one-horse plough. This plough takes a small shallow furrow to the left of the row, within three or four inches of the young plants, and lays it in the middle of the interval between the ridges. When this has been done on both sides all over the field, there will be small ridges formed between the prin-



cipal ridges on which the turnips grow. All weeds are thus buried, except between the plants in the rows, where they are taken out by the hand or hoe. Some time afterwards a narrow cultivator, like harrows with crooked tines, which are called *cats' claws* from their shape, is drawn over the last-made ridge to pulverise the earth and clear it from all remaining weeds; this is repeated more than once, if it should be thought necessary. Before the autumn rains set in, or the turnips have too wide spreading tops, a plough with a double mould-board is drawn along the middle of the intervals, and lays half of the pulverised soil on each side against the ridge on which the turnips grow; not to cover the roots and protect them from frost, as some think, but to supply fresh mellow earth for the extending fibres of the root to strike into. In heavy wet loams it may be necessary, in order to make a clean neat furrow between the rows, to let off any surface water, in the latter end of the season, with a double mould-board plough, and dig out deeper water-furrows with the spade across the ridges, where they may be required by the nature of the surface. But this is not often necessary in common turnip soils. By following the above system, Swedish turnips and even common white turnips may be raised with success on the heaviest soils; and if taken up early, and stored for winter use, they will leave the land in as good a state for wheat, with one or two ploughings, as if it had been fallowed. The carts which take off the turnips will not hurt the land, for the horse walks in a deep furrow, and the wheels move in similar ones, and thus the mellow earth is not trod upon. In order that the dung, which is not yet fully decomposed, may be spread evenly for the next crop, the ridges are often made in a diagonal line across the usual line of ploughing. When the turnips are off, one bout of the plough levels each of the ridges, heavy harrows level the whole, and it can be ploughed in proper stitches for the sowing of the next crop. Sometimes wheat is sown immediately, but more frequently barley with clover-seed in spring. In the latter case the Swedish turnips may be left on the ground all winter, and taken up or fed off early in spring.

Though you may traverse the whole of Northumberland without meeting with a single field of turnips sown broad-cast, the drilling of other crops is by no means so common as in Norfolk and Suffolk, where most of the turnips, on the other hand, are still sown broad-cast. The expense of the machines for drilling corn may be one cause of this, but it seems not sufficient to account for it.

It is well known to all good farmers that all the subsequent crops depend on the success of the turnips. These are the source from which manure is provided, and no crop will keep so much cattle during winter and early spring, with so little exhaustion of soil, as turnips. The manure abundantly put on the land to raise the turnips is a fund laid out at great interest for the benefit of the future crops; for the whole course is benefited by them, especially if they are fed off by folding sheep on them. Whether wheat or barley is sown after turnips, clover and grass-seeds are usually sown amongst it. The land being clean and in good heart, the grasses grow thickly and cover the ground well the year after. In the heavier loams, after the grasses have been once mown for hay, the land is depastured for two or three years, and then it is ploughed once and sown with oats. After oats come beans, with some manure, and wheat ends the rotation. This is considered the best course for keeping the land in a state of progressive improvement. On very rich soils another crop of beans or peas may be taken after the wheat, and then wheat or oats again. Few soils, however, except the richest and deepest, will bear this exhausting course; and it is more prudent in general to return to the turnips after the first crop of wheat.

On light gravelly soils, where the clover and grasses soon fall off, the Norfolk system answers best. The turnips are fed off with sheep, or, where the crop is heavy, half the turnips are drawn for oxen and cows, and the other half fed off; or, which is a late improvement, they are cut into slices or strips by a machine. and given to the sheep with cut clover hay in shallow troughs on the ground from which the turnips were drawn. In this way the turnips go much farther; and lambs and old ewes will thrive and fatten on them, which they could not have done in the old way for want of teeth to bite them. After turnips come barley and broad clover, with a small portion of annual rye-grass, mown once for hay and ploughed up for wheat. The next course is the same, with the variation of some substitute for the broad clover, which should not be sown on the same land oftener than once in eight years to ensure good crops. Part of the land may be in peas or tares to cut green, and part in grass-seeds without clover, according to the judgment of the farmer. There are some very heavy and wet soils in the county, which will not readily bear turnips, and where the sheep cannot be folded in winter, nor the turnips carted off without greatly injuring the land. There a fallow is unavoidable at least once in six or seven years. In other respects they are cultivated in a similar manner with good loams. The practice of thorough-draining, which is spreading rapidly, will probably soon banish clean fallows, and substitute turnips in their place, even in the most retentive soils, which will in time be converted into rich loams by the effect of cultivation, loaming, manuring, &c., as may be seen in many old gardens, of which the natural soil was once a retentive clay.

Potatoes are raised to a considerable amount on some very good sand and loams. They require land in good heart; for whatever may have been said or written to the contrary, they very much exhaust the land, and should not be repeated oftener than once in ten or twelve years on the same spot. The best land to plant potatoes in for human food is that which is broken up from two or three years' old grass. For cattle they may occupy a portion of the turnip-field, and be cultivated in similar ridges, with this difference, that the sets, or cut potatoes, are put immediately on the manure in the furrow, and covered over with four or five inches of earth by the plough. As they rise out of the ground they are moulded up by the plough; and this is repeated, with a plough made on purpose, with two very wide mould-boards, as often and as deep as the soil will allow. Thus 400 bushels, or 20 tons, of the large cattle potatoes may be raised on an acre of good land: they are good for every kind of stock when boiled or steamed. Although the immediate profit in this way is much inferior to that of a smaller crop of more edible potatoes, sold in the market, the manure produced amply makes up for the difference, unless potatoes sell at a high price, as is the case near manufacturing towns.

The instruments of tillage are mostly of improved make. The ploughs are generally iron swing-ploughs, on the principle of the old Rotherham plough, which was copied from the Belgian plough, and improved by Small and others. The harrows, rollers, scarifiers, &c. are as in other counties. The turnip-drill has been described, and there are various improvements daily made in the construction. The best sows two rows at once, and has a roller before and one behind, thus combining all the necessary operations connected with the depositing of the seed. Single-horse carts are more common than any others, and used for all purposes, especially the conveyance of lime and other manures from a distance. Bones ground to a moderate size are now extensively used as a manure for turnips, especially on dry gravelly soils; and they have greatly improved all the crops, by securing that of the turnips, at a much less expense of farm-yard dung. Threshing-machines, moved by water, wind, or horses, are thought essential on the larger Northumberland farms; and there is no prejudice against them among the labourers, but on the contrary. The labourers are industrious and honest: they are mostly paid partly in grain, by the keep of a cow, and a cottage rent-free, with other advantages. [BERWICKSHIRE.] The unmarried servants are boarded on the farm, as in Scotland.

There are not many meadows, properly so called, in Northumberland, and few are artificially irrigated. Some rich upland pastures are mown annually, or every two or three years, for hay, and fed off the remainder of the time. Some are occasionally invigorated with manure, chiefly composts of earth, lime, and dung, well mixed and incorporated, which is put on in winter, when farm-work is slack, or, which is better, immediately after the hay is taken off, when it is soon washed in by the autumn rains. The hay produced from clover and artificial grasses, of which there is a considerable quantity on all well-managed farms, furnishes the great supply of winter fodder for horses, and is a useful addition to the turnips for feeding cattle.

The cattle in Northumberland are generally of good breeds, mostly short-horned. Those bought to fatten are chiefly Scotch. In noticing the cattle of this county we cannot pass over the wild breed, in the Earl of Tankerville's park at Chillingham. They are mere objects of curiosity, never having been made useful for farming purposes; nor does it appear that they have been used with any advantage for crossing with domesticated breeds. They are of a light cream colour, with black muzzles. Their flesh is said to be good and succulent, when they are killed in condition, which must be done by shooting them like deer. The cows kept for the dairy are almost invariably of the short-horned Durham breed; and many remarkably fine heifers are reared in the county, some of which travel southward and supply the large dairies of the London milkmen. The calves are reared on milk at first, gradually mixed with water and meal, till they can live on grass alone and run in the pastures. The first winter they have turnips and straw, and are often sold in calf and in good condition the ensuing autumn. If they are kept over the second winter, they have the same food as in the first, with the addition of a little hay occasionally. They are then kept for private use as dairy cows, or sold with their young calf soon after calving, which is generally in April or May. Great attention is paid by some breeders to have a good bull; and very high prices are given for the use of one of a good breed and with *good points* for one season. The breeding of bulls is a separate business, and requires much experience and judgment.

Excellent farm-horses are bred in Northumberland. They are active, with clean legs, and are very muscular and hardy. Four fat horses in a plough or team, such as are seen in Kent, would be a curiosity in the northern counties. They like fat bullocks, but prefer hard wiry sinews in horses. It is not often that a plough is seen with more than two horses yoked to it, and this only for trench or subsoil-ploughing, a practice which is beginning to gain ground, as the next improvement after complete draining. The horses are not permitted to be idle. The example of those who work in the collieries teaches the farmer what horses can do; and if they are worked harder than in the south, they have a larger quantity of corn given them. A horse in a single cart will go to a distance of eighteen or twenty miles for lime or coals, and return in the twenty-four hours; and this he will do four times, and even oftener, every week. It is no wonder that they carry no unnecessary fat about them.

The sheep are chiefly of the native Cheviot breed, a useful hardy sheep, with a small fleece of moderate wool. A cross between a Cheviot ewe and a long-woolled ram is said to produce a useful breed, improved in the carcass and in the bulk, if not the fineness of the fleece. On highly improved farms the Leicester and South-down breeds, and almost every other, may be found; but as many of the pastures are wet, and apt to cause rot in the sheep at particular seasons, most farmers buy them in to eat their turnips, and sell them off when fit for the market, before there is any fear of their being tainted.

The Cheviot sheep are described as follows:—They have a fine open countenance, with lively prominent eyes, a long body, with a want of breadth at the chine and breast. They have fine clean legs without wool on them, and when fat their carcass will weigh from six to eight stones of 8 lbs. the stone. The fleece is from $2\frac{1}{2}$ lbs. to $3\frac{1}{2}$ lbs. weight, of a mixed wool, which might probably be much improved by care in selecting the ewes and rams kept for breeding, as was done with the South-down sheep by Ellman in Sussex. Some pains have already been taken to improve the breed, and with good results. The principal farms in Northumberland are let on lease for twenty-one years to highly respectable tenants with sufficient capital. No more need be said to account for a high state of cultivation.

There are no very extensive old woods in the county, but many thriving plantations: there is a constant demand for small timber for the use of the coal-mines, which makes it profitable to cut young saplings, and the trees are not often permitted to acquire the size of large timber. The larch is a profitable and favourite tree in all young plantations, and thrives well in most situations, from the sides of the rivers to near the tops of the highest hills.

NOTTINGHAMSHIRE AGRICULTURE. The climate of this county is dry and healthy, and upon some of the light lands the harvest is as early as in many counties more to the south. The face of the country is undulating, without rising to any great height. The high hills of Derbyshire intercept the westerly winds, and cause the clouds to discharge their moisture before they reach Nottinghamshire. The heaviest rains are when the wind comes from the east.

The county may be divided into three districts with respect to soil. In the first, sand and gravel prevail. This extends along the vale of Trent to the borders of Lincolnshire, and to the north of Nottingham along the ancient forest-land and border, in a strip of land about thirty miles long and from seven to ten miles broad. The next is the clay, which lies between the Trent land and the last-mentioned strip, and in a part of the southern extremity of the county towards Leicestershire. The third district is that where limestone and coal are found. This lies partly on the borders of Derbyshire, and partly on the south-east, towards Leicestershire and Lincolnshire. Gypsum of an excellent quality is found on Beacon Hill, near Newark, and at Red Hill, at the junction of the Trent and Soar.

This county, of which a great portion was once forest-land, contains many fine parks and seats. In consequence of this many domains are held in hand by wealthy proprietors, and the buildings attached to these estates are substantial and convenient. An improved state of agriculture also results from this circumstance, and crops may be seen which, to a superficial observer, might appear to proceed from a much richer soil than it is in reality. There are, no doubt, many fertile spots; but the generality of the lands are not above mediocrity, and some are very poor. The farms are of moderate size, and the tenants are mostly at will, trusting to the honour of their landlords not to remove them without sufficient cause, nor to raise the rents beyond a fair rate. The same families have continued in some farms for generations.

The old plough of the county is a swing-plough, but wheel-ploughs have been introduced, and are very generally used. The other agricultural implements are such as are used in the adjoining counties; and the increased means of communication have brought every improved instrument, such as cultivators, scarifiers, and drills, into partial use. The gentlemen's bailiffs, as everywhere else, are ready to try new inventions. The old farmers are cautious, and wait till they are satisfied of their utility, which they are often slow in acknowledging.

Before the enclosure of the forest-lands and the commutation of the forestal rights, a great portion of the land could not be cultivated to advantage or improved. The practice of leaving the land in grass for several years, and then breaking it up for a course of cropping, prevailed in most parts of the county, and, being better regulated, has introduced a modified convertible system, to which the lighter soils are well adapted. Turnips are cultivated to a great extent. Along the river Trent are some very good meadows and pastures, in which bullocks are grazed to advantage. The breeds which are preferred are the Hereford and the short-horn for the best pastures, and the small Scotch for inferior. There are not many dairies, although some good cheese is made here and there. The dairies are chiefly along the Soar. The sheep are mostly of the Leicester breed. Some South-downs are, however, met with on many farms.

Before the common fields were enclosed

and divided, the system of cultivation on the clay soil was very imperfect. A fallow, often not half cleaned, and but slightly manured, was followed by a crop of wheat, which was thought abundant if it reached three quarters per acre, and moderately good at little more than two. Beans and peas mixed together often followed; and, in spite of sowing thick, which produced straw and little corn, the weeds were not kept down; and the crop of oats which followed was generally half smothered with weeds, which the next fallow could not eradicate. Now a better system has succeeded; and although the fallow is thought absolutely indispensable, yet the tillage is better, the crops cleaner, and the produce more abundant.

There are many hop plantations in the county, which, in some years, give a good profit to the grower. There are excellent market-gardens in the neighbourhood of Newark, Nottingham, and other towns, the sandy soil being very favourable to the cultivation of roots and vegetables. There are some good orchards on the heavier soils, but no cider is made in the county.

The remains of the old forest-trees are still to be met with in parks, where they have been preserved as ornaments; but they have been greatly thinned in the woods which still remain. A better system of forest management has been introduced of late years, and more attention is paid to the growth of navy timber. Many new woods and plantations have been made in those parts of the forests which have been granted to individuals or allotted on enclosures. Very extensive woods have been planted on the estates of the Dukes of Newcastle and Portland.

OATS (*Avena sativa*) is a well-known species of the genus *Avena*, a plant of the family of the Gramineæ, in the class Triandria Digynia of Linnæus. We shall here only consider those varieties which are cultivated for their grain, principally as food for horses, and in some cases for men also, when ground into oatmeal or grits.

The great use of oats, and the ease with which they are raised on almost every kind of soil, from the heaviest loam to the lightest sand, have made them occupy a place in almost every rotation of crops. Before agriculture had been subjected to regular rules, the result of long experience, the land was often sown as long as any return could be obtained, before any means of recruiting it with manure were thought of; and the last crop which would return any increase of the seed was generally oats. After this the land, no longer repaying the labour of ploughing and sowing, was abandoned, till, by length of time and the decomposition of roots and weeds, some renewed fertility was produced. Of all the plants commonly cultivated in the field, oats seem to have the greatest power of drawing nourishment from the soil, and hence are justly considered as greatly exhausting the land. Some farmers on this account prefer buying all their oats in the market to raising them on their own land. Where the soil is well adapted to the growth of wheat and barley, which bear a better price, this may be a judicious plan; but as a general rule, it is always more profitable to raise oats for home consumption than to trust to a fluctuating market. With proper management, a crop of oats may give as great a profit on the best land as any other crop, when it is considered that it requires less manure and produces an abundance of straw, which is very fit for the winter food of horses and cattle, especially when aided by roots or other succulent food.

To make a crop of oats profitable, some attention must be paid to the preparation of the soil and to free it from weeds; for to sow oats on a foul wheat or barley stubble slightly turned in by the plough, as is sometimes done, is the reverse of good husbandry.

The best oats are raised in Scotland and in Friesland, and in both countries the land is carefully cultivated. In Scotland, oats are generally sown on a grass layer which has been in that state for some years, and sometimes on old pastures which are broken up for the purpose. The crops exceed in bulk and weight of grain all that the most sanguine person, unacquainted with the system, would expect, and in many seasons, not favourable for the wheat crop, oats are much more profitable. Wherever the land is not of a good quality, and wheat is apt to fail, oats are a much safer crop, especially in retentive soils, as rye is on poor sands.

When oats are sown after turnips, cabbages, or any other green crop, the land should be well ploughed, if the green crop was not consumed on the spot, and a moderate supply of manure will be well repaid by the increased produce. A heavy loam is best suited for oats: they require a certain degree of moisture, and a deep soil is very favourable to their growth. On land which has been trenched, or where the subsoil plough has been used, after careful draining, if required, oats will thrive wonderfully, without requiring so rich a soil as barley or wheat. The roots are hardier and have a stronger vegetative power. When once they have struck deep into the soil, a good crop, according to the quality of the land, may be relied on.

When oats are sown after artificial grasses, the land is seldom ploughed more than once, and the seed is sown on the fresh mould which has been turned up; but unless the land be very free from weeds, it would be better to plough the sward with a shallow furrow early in autumn. Before winter the scarifier would break the rotten sward, which might then be buried deep by another ploughing. The land would be ready for sowing early in spring, which is a great advantage, both as to the quality of the oat crop and the earlier harvest, especially in those districts where the latter part of the autumn is apt to be stormy and rainy. The land thus treated would be clean, and the fallow, which is often resorted to, of necessity, after a crop of oats, might be dispensed with, as the weeds have been destroyed and buried deep.

When oats are sown on light land after turnips, which have been eaten by sheep folded on them, it may be ploughed with as shallow a furrow as will turn in the surface: the preparation for turnips will have sufficiently moved the soil; and the manure of the sheep should not be buried too deep. On poor moist land oats are more profitable than barley. Clover and grass seeds may be sown among them with equal advantage, as they will seldom grow so high as to be laid and smother the young clover; and barley is very apt to fail on land subject to retain the water.

In sowing oats more seed is often used than of any other grain, because, although the plants tiller where they have room, the straw of the second shoots is weaker, and the grain is not ripe so soon as that of the principal stem; but when the plants rise close and thick, there are no tillers, the main stem is stronger, and the corn is more plump and equal. Six bushels of oats are often sown on an acre; but if they are drilled, four bushels are sufficient, and when dibbled, which is sometimes the case in Norfolk and Suffolk, much less seed is used. A good preparation of the land is of more consequence than a superabundance of seed.

In a field where oats are sown broadcast, and covered by the harrows, many seeds remain exposed to the depredation of birds, which soon find them out at a time of the year when food is scarce; but when they are drilled or dibbled, all the seed is buried and germinates, without any loss. When the seed is sown and ploughed in, the same object is attained; but as the furrow must be shallow in order that the seed may not be buried too deep, the land must have been ploughed before to a considerable depth, unless it be after turnips fed off by sheep, in which case ploughing the seed in is a good practice: in either case four bushels of seed per acre is an ample allowance.

When the ground has been well prepared, there is no necessity for weeding or hoeing the crop as it advances; but if large weeds appear, such as charlock, May-weed, docks, or thistles, they must be carefully weeded out, or else the ground will be so infested with their seeds or roots, that it will be difficult to eradicate them afterwards. Oats, when fully ripe, are very apt to shed, and many are lost for want of attention. As soon as the straw turns yellow under the panicle, the oats should be reaped, however green the lower part of the straw may be: the straw will be better fodder for cattle, and all the corn will be saved. Oats are generally mown with a scythe, and raked into heaps to dry like hay; but this is a wasteful and slovenly practice. A good crop of oats should be reaped, like wheat, close to the ground, and tied in sheaves. A cradle scythe or a short Hainault scythe does the work well in the hands of an expert mower, who should be followed by binders, who gather the straw with their hands, and lay it regularly on the ground, if it be not fit to tie up immediately: the straw should afterwards be tied up into sheaves, and set with the corn uppermost in shocks of ten or twelve sheaves, leaning against each other, and open at bottom, in order to allow the air to pass through. Thus, in a short time the oats become sufficiently dry to be stacked, or carried immediately into the barn. The produce of an acre of oats varies according to the soil and preparation, from four to eight and even ten quarters.

Oats ground into a coarse meal form a considerable portion of the food of labourers and many men in the middle ranks of life in Scotland, Ireland, and the north of England. The meal is simply stirred into boiling water with a little salt, until it becomes of the consistency of a hasty-pudding; it is then called porridge or stir-about; and when eaten with milk or treacle makes a wholesome and palatable food. It is sometimes mixed with the thin liquor of boiled meat, or the water in which cabbages or kale have been boiled, and acquires the denomination of beef-brose or kale-brose. When made into a dough with water, and baked on an iron-plate in thin cakes, it makes a bread, which is very palatable to those who are accustomed to it, and who often prefer it to wheaten bread. Its use was once almost universal in Scotland, which has in consequence been called the Land of Cakes. In Germany and Switzerland the coarsely bruised oat-meal is put into an oven till it becomes of a brown colour; it is then called haber-meel, and is used in broths and pottages, as the semolina, made from wheat, is used in France and Italy. The coarsely-broken grains, after the husk has been removed, form grits, which are extensively used to make gruel for children and invalids. The chaff of oats put into a canvas bag forms a good substitute for feather-beds for the poor, and is far more wholesome than feathers, from the ease with which it may be renewed at little or no cost.

In some countries the oats are given to horses in the straw, without thrashing them; and where the quantity can be regulated, the practice is good. The horses masticate the corn better in the chaff, and the straw is wholesome; but where horses do hard work, they would be too long in eating a sufficient quantity, and it is better to give them oats thrashed and cleaned, with clover hay cut into chaff. When hay is dear, it is often cheaper to increase the quantity of oats, and to give it with wheat-straw cut fine. In this way very little hay is required. The calculation is easily made when we consider that a pound of good oats gives as much nourishment to a horse as two pounds of the best clover, or sainfoin hay. A truss of hay of 56 pounds is therefore equal to 28 pounds of oats; or a bushel of the best oats will go as far as one truss and a half of hay; and if this quantity is worth four shillings, which is at the rate of 4*l.* 16*s.* per load of thirty-six trusses, the equivalent price of oats is 32*s.* per quarter.

Farmers who have hay-ricks from which they often allow their men to take as much as they please for their horses, will carefully measure out the oats, which probably are much cheaper. Some men who keep many horses, cut all the hay into chaff by a machine, and mixing this with a proper proportion of oats, feed all their horses in mangers with a certain allowance of the mixture, a practice much more economical than that usually adopted. In France and Germany the practice of baking oats, as well as rye, into loaves for horse-food, is gaining ground, and is said to be attended with an evident saving of food.

OX or STEER is the castrated male of the bovine race: he is called an *ox-calf* or *bull-calf* until he is a twelvemonth old, a *steer* until he is four years old, and after that an *ox* or *bullock*. A sufficient number of the most likely of the male calves being selected for the future propagation of the breed, the others are castrated between the first and third months.

The advantages derived from the performance of this operation are very great. The nutriment, which is no longer directed to the sexual organs, goes to the general enlargement of the frame; the propensity to fatten is abundantly increased, and the animal becomes far more docile and tractable. The use of the ox in agricultural and other labours may be traced in almost every country, and to periods of the remotest antiquity.

The education of the steer should commence between the second and third year. At an earlier period he has scarcely sufficient strength, and at a later one he may have become obstinate and self-willed. His education should be founded on patience and kindness, and then the term of it will be far shorter than is generally imagined, and the result will be permanent.

There has been much dispute with regard to the comparative advantage of the employment of cattle and horses in agricultural labours. The former are said to cost less and to be supported at less expense. For the latter it is pleaded that a smaller number are needed—that the work is, on pressing occasions, far more quickly performed, and that it is always abundantly greater. The plain matter of fact however is, that although the ox is still used for slow and heavy work on many farms, he is not so generally employed as he used to be, even by his warmest advocates, and the use of him has been completely abandoned by a very considerable number of agriculturists.

In the native counties of the best breeds, he is still admired and valued as a beast of draught, but by the majority of farmers his value is now chiefly or solely estimated by the quantity and quality of the meat that he will yield, according to the care that is bestowed upon him and the expense that is incurred. He is in the fullest perfection at four years old, and he will then prove more profitable to the farmer than if he were worked four or five years longer, when the quality of his flesh will be deteriorated and his disposition to fatten considerably impaired.

The principal *diseases* of cattle may be conveniently made the subject of consideration in the present article. They are not so numerous as those of the horse, but there is often considerable difficulty attending the treatment of them. From the peculiar temperament of cattle and the comparatively great quantity of blood which flows in their veins, promptness in the recognition and the treatment of disease is of far greater consequence than in the horse, rapid as is often the progress of his maladies. Few of the diseases of the horse destroy him at once; but there are many maladies of the ox which must be met at the instant, or they will be uselessly struggled with afterwards. Let the owner and the veterinary surgeon take good heed of this.

The *diseases of calves* should be first considered. They are as numerous as those of the colt, and more fatal. At the head of them stands *diarrhœa.* This sometimes occurs when the calf is suffered to continue by the side of its own dam. Both starvation and excess of food in the mother will produce it. More particularly will this be the case when a foster-mother is employed. If she has calved but a very few weeks before the newly-dropped young one is put to her, the bowels of the calf will almost certainly be disturbed. Where it can conveniently be accomplished, every calf should be reared by its own dam. A state of considerable purging should never be neglected many days, and more especially if the animal loses its gaiety or is in evident pain, or the dung is unusually offensive or tinged with blood. The grand cause of this is acidity in the stomach or intestines, which gradually causes inflammation of the inner coat of these vessels. The irritation here set up is communicated to the constitution generally, and exhaustion and death ensue. Then recourse must be had to a compound medicine, the value of which cannot be too highly estimated. It is borrowed from the work on 'Cattle,' published by the Society for the Diffusion of Useful Knowledge, and the farmer should never be without it. There should be an alkali, chalk, to neutralise the acid; an astringent, catechu, to arrest the discharge; a sedative, opium, to allay the irritation; and a carminative, ginger, to support the strength of the patient. These should be mingled in the proportions of eight parts of the first, four of the second, one of third, and two of the fourth. A large teaspoonful of this powder should be given twice or thrice in the day, according to circumstances.

Costiveness is a contrary disease to this. It should never be suffered to continue long, for it is fraught with danger. The best aperient for calves and cattle is Epsom salts, in doses of from one to two ounces, with a scruple or half a drachm of ginger.

Cough should be promptly attended to the moment that it is heard. A dose of physic, small doses of powdered foxglove, with nitre, or, in bad cases, a slight bleeding, will usually remove it.

In proceeding to the diseases of adult cattle, we are struck with the numerous *diseases of the eye*. *Ulceration of the lids* will generally yield to the nitrated ointment of mercury locally applied, and a course of alterative medicine. *Warts* should be excised by means of a pair of scissors, and the root touched with nitrate of silver.

For inflammation of the *haw*, or membrane at the corner of the eye, a weak goulard lotion, or the tincture of opium, lowered with ten times its quantity of water, will be useful; but if there is any fungous growth on the haw, extirpation will afford the only cure. *Inflammation of the eyelids* will generally yield to fomentations of warm water. For *inflammation of the eye*, warm or cold fomentations, the former at the first, and the latter a day or two afterwards, with the opiate lotion at the commencement, and a very diluted one of white vitriol—two grains to the ounce—when the inflammation is subdued, with a moderate bleeding or a dose of physic, will constitute the most successful means of cure. *Ulceration of the eye* will be best treated with the opiate lotion, but *cataract* and *gutta serena* do not admit of cure.

In *fracture of the horn*, if the bones are not quite separated, they may be bound together by tarred cords or splents. If there is a perfect fracture of the bone, it should be sawn off as closely as possible to the head, and a hot iron passed over the surface.

Water in the head in calves, known by the enlargement of the head and the stupidity of the animal, admits not of any cure. The *giddiness* which is sometimes observed in them and even in the adult beasts—turning round and round—is usually hopeless.

Apoplexy, or sudden determination of the blood to the head, produced by the forcing system being carried too far and the process of fattening hurried too rapidly on, can be cured only by the most decisive measures. The animal that is thus *struck* must be bled until he faints, and powerful purgatives administered and continued.

Phrenzy is produced by the same cause, and can only be cured by the same treatment. In these cases, 15 or 20 drops of the croton oil should be added to the aperient.

Locked-jaw too frequently bids defiance to medical treatment. The only hope of cure consists in active bleeding and the continued use of Epsom salts and croton oil, until the bowels are opened. Immediately after the bleeding, the jaws will usually be found sufficiently relaxed to admit of the administration of medicine. This golden opportunity should never be lost. As an adjuvant, a seton of black hellebore in the dewlap may be tried.

Young cattle are occasionally subject to *fits*. Almost without warning, the beast staggers, falls, bellows, and is convulsed in every limb. This is the consequence of over-heating or over-driving, or both. The physic and the fleam must be here put into active use. Perhaps it would be prudent to send such a patient to the butcher with very little delay.

Rheumatism.—There are few diseases of more frequent occurrence among cattle than this. It is not long absent in a low marshy situation, and it is the constant attendant on careless or cruel exposure to cold and wet. It is recognised by the difficulty of motion and the occasional expression of pain. The cure is comprehended in one word, 'comfort.' A little mild physic, with warm comfortable drinks and gently stimulating applications, will hasten and confirm the cure.

Connected with or a consequence of rheumatism is *swelled joints*, yielding sometimes to stimulating embrocations and comfortable lodging. There are, however, other tumours unconnected with the influence of cold; such are fluctuating tumours, usually about the knees, which require stimulating embrocations and the occasional use of the *budding-iron*, followed by the application of a blister when the fluid has escaped. Other tumours, also in the neighbourhood of joints, are of a hard character. They will generally yield to frictions with an ointment of the hydriodate of potash, this drug being also administered internally in doses of 6 or 8 grains daily. The too frequent consequence of these affections is *palsy*, at first confined to certain limbs, but gradually spreading over the frame, being however most visible in the hind extremities. Here again the whole treatment may be included in the comprehensive word 'comfort.' Small doses of physic, the administration of the white antimonial powder, the use of stimulating embrocations, with warm lodging and good food, especially mashes, will be useful adjuvants.

As for that species of nervous affection *rabies* or *madness*, it admits not of cure; and it has but one cause, namely, the bite of a rabid or mad dog. If a farmer knows that certain beasts have been bitten, or has strong reason to suspect it, he will act wisely in sending them to the butcher, for after the disease has once appeared, there is no cure, and the meat is spoiled.

It is time to recur to the diseases of other systems and parts. Too frequent and destructive is that inflammation of the tongue and mouth, recognised by the name of *blain*. It consists of vesicles and tumours occupying the side of the tongue and the membrane of the mouth, speedily ulcerating, becoming gangrenous, producing much swelling of the face and head, and rapidly destroying the animal. It often appears under the form of an epidemic, and it is frequently contagious. The mouth should be well cleansed with a solution of the chloride of lime. Blood should be abstracted in an early period of the disease, and mild purgatives administered; but if the complaint has attained its height before any treatment is adopted, the chloride of lime should still be used, and also the physic, but it should be accompanied by some stimulating ingredients, as gentian or ginger, or both.

All cattle are subject to *fever*. The dry muzzle and the heat at the root of the horn, and the heaving at the flanks, are sufficient proofs of it. If this is early observed, a dose of physic and one or two mashes will usually set all right. At times, however, the attack is sudden and more violent, and danger is evident from the very commencement. The farmer recognises this affection by the terms *black-quarter*, *quarter-ill*, *blood-striking*, &c. The beast is seen with his head protruded, his nostrils expanded, and his flank heaving, the breath and horn hot, and the eyes bloodshot. There is a peculiar crackling sound if the loins are pressed upon, and the slightest pressure gives extreme pain. Ulcers appear on various parts of the body, and every part seems tending to corruption. This disease is sometimes epidemic, but it is quite as often the consequence of the fattening process being hurried on too rapidly. In the early stage of such a complaint, the treatment will consist of copious bleeding and brisk purging. These should be continued until they produce their effect, and then some sedative medicine, as foxglove or emetic tartar, administered, and persisted in until the disease is evidently yielding. After this some mild stomachics, as gentian and ginger, should be administered.

Too frequently, however, the treatment has not been sufficiently active or was not commenced early enough, and a peculiar low fever begins to be apparent. There is dysentery, which no astringent will arrest; ulcers, which defy the power of every disinfectant; and the animal dies one mass of putridity. In this stage of the disease, and also in many of the complaints that have been described, the assistance of an educated veterinary surgeon should be requested, for the treatment is complicated and difficult to a great degree.

The diseases of the respiratory system require particular notice: most frequent among them is *cough*. It is too little regarded by the owner, but it is often the unsuspected messenger of consumption and death. There is no rule of more universal application in cattle practice than that a chronic cough is the forerunner of everything that is bad. While the beast feeds well, and the muzzle is cool and moist, and the flanks are quiet, the dairyman feels no alarm, although he hears the cough almost every time that he enters the cow-house. By-and-by, however, he finds that the cow is losing condition, and her quantity of milk is evidently diminishing, and he begins to think that there is some necessity for attending to the case. It is then too late: the seeds of consumption are sown, and he must part with her immediately, or she will pine away and die. In every case of severe cough, moderate bleeding and purgation should be had recourse to, with warm mashes and a comfortable cow-house. The same treatment will apply to the *epidemic catarrh*, which is sometimes so prevalent. When this catarrh assumes a malignant form, as in *murrain*, the treatment will be little different from that of black-quarter. *Sore-throat*, or inflammation of the upper part of the throat and the back of the mouth, should be treated as cough, except that a blister or some stimulating application should be had recourse to. The same may be said of *bronchitis*, but there is a peculiar form of it to which young cattle are subject, and which bids defiance to all medical treatment, namely, the choking of the windpipe and passages of the lungs by an innumerable host of minute worms. No medicine will be of avail here.

Cattle are comparatively seldom attacked by pure *inflammation of the lungs*. This disease principally occurs when the beasts have been compelled to travel too far or too fast, and when they are exposed to sudden variations of temperature. It may be known by the drooping head, the heaving flank, the frequent painful cough, the obstinate standing, the hot mouth, and the cold feet. The animal should immediately be bled until the pulse faulters. In all cases of inflammation and danger, this is the guide. No specific quantity should be ordered or taken. The faultering of the pulse is the unerring indication of the abstraction of the proper quantity. If the pulse again throbs hardly, the bleeding should be repeated. The bowels should be opened by means of Epsom salts. Setons in the dewlap should not be forgotten, and blisters should be rubbed on the sides with right good earnest The diet should consist of thin gruel and mashes. *Pleurisy* may often be distinguished by a peculiar symptom, twitchings and shiverings about the chest and shoulders, these being the parts external to the seat of pain. Little waves appear to be stealing over the skin, and the animal shrinks when the sides are pressed upon. The treatment is the same as in inflammation of the lungs. *Consumption* is the most frequent and fatal of all the diseases of the chest in cattle. It is the consequence or the winding up of every other pulmonary complaint. It is distinguished by a feeble and hoarse cough, evidently accompanied by pain, and interrupted before it is perfectly completed. For awhile the beast may continue to thrive; she, for it is oftenest a disease of the female, may increase in condition; but she will presently begin to waste rapidly away. Medicine is powerless in this disease. The animal must be disposed of or destroyed.

First among the diseases of the *digestive* system is *choking*, or the stopping of a piece of carrot or turnip, or other hard substance, in its passage down the gullet. The cart-rope or the cart-whip is resorted to, in order to force it along the canal, and much mischief has ensued from the violence that has been resorted to on these occasions. Probangs are now constructed at trifling expense, and may be had from most surgical-instrument makers in town and country, by means of which the purpose may be readily effected, and without danger.

From the gullet the food passes into the stomachs of the animal, of which there are four. The first is the *rumen*, or paunch, into which the imperfectly masticated food, as it is hastily gathered, descends. It is there macerated and prepared to be returned for a second or more complete grinding. Sometimes this stomach becomes overloaded with food: this is the *grain-side* of the dairy. The animal refuses to eat, he becomes uneasy, moans, swells at the flank, and a kind of unconsciousness gradually steals upon him. The symptoms are often treacherous, and would deceive him who was not thoroughly acquainted with the diseases of cattle; but the introduction of the probang, if necessary, will reveal the real state of the case. The stomach-pump will be of admirable use here. Any quantity of fluid can be injected into the stomach, and the hardened mass may be rendered more fluid, and removed by means of the pump; or, if the stomach is too full to admit the probang, and to be thus evacuated, an incision may be made in the flank, and the accumulated mass withdrawn by the hand.

At other times an unnatural fermentation commences, and the stomach is inflated with gas. One look at the sides will sufficiently indicate the inflation of the paunch. This is termed *hoove*. The first indication of cure is to get rid of the gas. This may be accomplished by the introduction of substances that will chemically combine with it. The chloride of lime will effect this. The principal gas in the inflated stomach is hydrogen. The chlorine leaves the lime and combines with the hydrogen, and the compound does not occupy a thousandth part of the space previously occupied by the hydrogen. Two drachms of the chloride of lime will form a cheap and a very efficient agent. But if this is not at hand, then a puncture may be made into the left flank with perfect safety. If this is done with a trocar, the canula may remain in the wound, and the gas will continue to be extricated while any considerable portion of it remains. In default of a trocar, a penknife may be used; but as the upper portion of the stomach sinks with the disengagement of the gas, the aperture through the skin and that into the rumen will cease to be accurately opposed to each other; and some of the gas and the contents of the stomach will enter the cavity of the abdomen, and will be the cause of future illness, or, perchance, of death.

The gas having escaped, a purgative should be administered, with a double dose of the aromatic, in order to excite the stomach to resume its duty.

The *loss of cud*, or the cessation of rumination, is only the indication or the consequence of other disease, and will cease with it. If the nature of that disease is not clear, a dose of physic, with the usual or more than the usual quantity of the carminative, may be given.

The diseases of the second stomach, the *reticulum*, or *honey-comb*, are few, and not easily distinguished. The simple function of that stomach is to prepare the pellet of food for remastication.

The third stomach, the *manyplus*, has more to do. The food which has not undergone sufficient comminution in the second mastication is seized by the rough and powerful leaves of this stomach, and is ground down, as it were, in a living mill. Sometimes, however, there is a deficiency of moisture in this stomach, or the muscular apparatus of the leaves does not act with sufficient energy; and at length the manyplus becomes perfectly paralysed by the distention caused in consequence of the undue quantity of food which is accumulated in it. This is known by the name of *fardel-bound*. The symptoms are not always evident. Dullness, want of appetite, disinclination to move, and costiveness, are among the usual indications. The treatment is simple, but too often ineffectual. It consists in the frequent administration of small doses of purgative medicine, with more than the usual quantity of carminatives; at the same time, a small stream of warm water is, by means of a horn or the stomach-pump, made to flow down the gullet and pass through the canal at the base of this stomach, thus gradually dislodging and washing away a portion of the accumulated and hardened contents.

The principal disease of the *abomasum*, or fourth stomach, is inflammation, designated by evident uneasiness, the resting of the muzzle on the situation of this stomach, or a peculiar stretching out of the fore-legs. Venesection and purgatives should be used in this case. Of the indications of disease in the *spleen* little is known. Inflammation is often found in it, with enlargement, induration, or softening of its substance. These circumstances, however, are rarely suspected during life.

To *diseases of the liver* these animals appear to be peculiarly prone. A yellowness of the skin betrays the existence of biliary affections in a great proportion of the inhabitants of every dairy. When acute inflammation of the liver exists to any considerable extent, not only this yellow tint of the integument will be found, but tenderness on the right side, fullness there, and the direction of the muzzle to it. The proper remedies are those used in inflammation of other viscera, with the addition of blisters over the diseased part. Chronic inflammation is far more prevalent than that which is acute. The indications are, want of condition, the same tint of the skin, and obstinate cough. The remedies are, gentle purgatives and succulent food. When obstruction of the biliary ducts takes place, there is a still deeper yellow, invariably accompanied by loss of condition. The animal then has *jaundice*, or the *yellows*. If much fever accompanies it, recourse must be had to bleeding and to physic.

Among the various intestinal diseases of the ox stands *enteritis*, or inflammation involving all the coats of the intestines. Young and fattening cattle are most subject to it. It is not, however, of very frequent occurrence, except as an epidemic, and then it is very destructive. *Wood-evil* and *moor-ill* are varieties of the same disease. They must be treated by bleeding, purgatives, blisters on the belly, mashes, and gruel.

Diarrhœa, or purging without the discharge of mucus mingling with the fæces, is produced by various causes, and particularly by a change or excess of food. It is often epidemic in the autumn. A mild purgative should first be given, and then the mingled but very efficacious medicine already recommended for a similar disease in calves.

Dysentery in the adult, as well as in the young animal, is indeed a fearful disease. Its causes are often obscure, and the means of successfully arresting its progress are a desideratum. Its principal characteristic is the discharge of mucus with the fæces, recognised by the appearance of bubbles standing for a while on the fæces. The length of time which they continue there unbroken may be considered as a kind of admeasurement of the quantity of mucus actually discharged, or, in other words, of the danger of the case. The progress of the disease is rapid or slow, according to circumstances which it is difficult to appreciate; but, in the usual course of things, the animal wastes away almost to a skeleton, and then dies.

Notwithstanding the purging, the first indication of cure is to bleed. It is an inflammatory disease, and that inflammation must be subdued. To the abstraction of blood should succeed the administration of an aperient, and castor oil, as being the least irritative, will be the best. Injections of gruel should follow; and when the dung has somewhat resumed its natural character, astringents may be administered, at the very head of which, in this case, stands opium: a little calomel should perhaps be mingled with it as an alterative, and, after that, the vegetable tonics must perfect the cure. Cattle are subject to *flatulent* and *spasmodic colic*, for both of which the vegetable tonics will be the best cure, with a little of the chloride of lime to absorb the gas, and the abstraction of blood if there is any inflammatory action. Walking exercise and friction of the belly should not be omitted. For *strangulation* of the intestines there is seldom any cure but by means of an operation which a skilful veterinary surgeon alone can perform. In cases of *constipation*, the aperients must sometimes be long administered before the bowels will be opened. There will be no danger in this, provided the Epsom salts, alone or with a small portion of aromatic powder, are administered. *Dropsy* in cattle seldom admits of cure. Although an operation may be resorted to, the belly fills again, nor will any physic or diuretic arrest the evil.

Among the supposed diseases of the urinary organs, but much oftener of the digestive ones, stands *red-water*, so called from the colour of the fluid which is evacuated. It is materially connected with the pasture, but sometimes it has an epidemic character. In the acute form of the disease the water is red. This must be combated by bleeding and purging, until the bowels respond. In chronic red-water the urine has a brown tinge at first, but a red hue gradually mingles with it. This is difficult to treat. The principal hope of cure consists in the exhibition of Epsom salts until thorough purging is produced. Some mild carminative may then be given. *Black-water* is only a variety, or the concluding stage of red water.

Puerperal fever, or dropping after calving, is a disease that has been very much misunderstood. A few days after calving, the cow suddenly loses all power over her hind limbs. She falls, and continues down three, four, or more days, until the power of voluntary motion returns, or she dies. It is inflammation of the womb or of the spinal cord, which extends to the organs of motion in the hind extremities. She must generally be bled, and always purged. No half measures will do here ; the bowels being once opened, the cow will frequently get up, and there will be an end of the matter. Injections will materially assist the action of the physic. Whatever apparent weakness there may be, no tonic must be given until the bowels have been well opened.

Garget is inflammation or ulceration of the udder. The milk coagulates in the bag, and produces inflammation there. In an early stage, the sucking of the calf will afford the greatest relief. If this does not succeed, fomentation must be had recourse to, and friction with an unguent composed of elder-ointment with an eighth part of camphor, and mercurial ointment. To this, if necessary, iodine may succeed, but it must be a last resource, on account of its absorbent power.

The treatment of *cow-pox* will consist in fomenting the teats, applying an emollient ointment, and giving a little physic.

The diseases of the feet must not be forgotten. *Foul in the foot* consists in ulceration about the coronet or between the claws, which produces great lameness, and, occasionally, loss of the hoof. It is very contagious: the treatment is simple. Every pustule, or collection of purulent matter, must be opened ; the horn which is separated from the parts beneath must be carefully and wholly removed ; a linseed-meal poultice applied for a day or two, and then the sores touched with the *butyr of antimony*.

Mange is a too frequent and very troublesome disease among cattle. An ointment, however, the basis of which is sulphur, with a small portion of mercurial ointment, daily and well rubbed on every affected part, will usually remove the complaint. Sulphur given internally will be a useful adjunct.

OXFORDSHIRE AGRICULTURE.

—The climate of this county is, on the whole, colder than its situation in the central part of the island would lead one to expect. The hilly lands in the north-western part are exposed and bleak; and the influence of the winds is only partially checked by the low stone-walls which form the usual boundaries of the fields. The poorer chalky soils also on the slopes of the Chiltern Hills are late in bringing crops to maturity. But notwithstanding this circumstance, the county may be reckoned amongst the most productive agricultural counties of England; and some of the land is of a quality which can scarcely be surpassed anywhere.

The soil may be divided into four distinct classes,—the rich red loam, the *stonebrash*, the chalky, and the irregular loams; and sands and gravels, which cannot be classed with any of the foregoing. Arthur Young, in his 'Report of Oxfordshire,' states the proportions of these soils as follows:—

Red land	. .	79,635 acres.
Stonebrash	. .	164,023 „
Chiltern chalk	.	64,778 „
Miscellaneous	.	166,400 „
Total	.	474,836 acres.

The red land is partly in old grass, in which state it is very valuable, and partly cultivated as arable land. A great portion of this division was formerly disposed in common fields, and consequently poorly cultivated. The enclosure and division of these lands have, in many cases, doubled their annual produce. A finer tract of land than this red loam is scarcely to be found. It is neither heavy nor light, wet nor dry, but easily worked at all times; and the crops, with a very slight attention to the cultivation, amply repay the farmer for his trouble and outlay. The land lets at a high rent; but the tenant can well afford it, his crops being certain, and almost always very abundant.

The stonebrash district, which extends from the borders of Gloucestershire across the country to the north of Oxford and Whitney, is of inferior fertility to the red land; but it is easily worked, and, having a porous subsoil, is not often injured by rain. The soil is formed of decomposed stone, chiefly chalk and sandstone. The subsoil is generally porous. Very fine marl is frequently found at a small depth under the surface; and where the soil is of a light quality with little cohesion, the application of marl is highly advantageous.

The chalk district is in the south-eastern portion of the county. The chalk is generally covered to a certain depth with a light calcareous loam, evidently produced by the decomposition of the chalk and the mixture of organic matter in a state of decay. Flints of various shapes are mixed up with the loam, and in some places are supposed to be essential to the fertility. The low lands in the valleys through which the rivers flow are in many places covered with the finest herbage, and maintain much cattle. A part also is cultivated as arable land, and in the hands of regular gardeners would make excellent market-gardens: as it is, it produces great crops of barley, clover, beans, and wheat, and, when properly managed, heavy crops of turnips.

Besides these distinct soils, there are many of a mixed nature, varying in texture and quality without any regularity. Where they are incumbent on a porous subsoil, they are mostly fertile. Some few consist of poor sands or wet clays, which form the extremes, and are very unproductive until they are corrected and improved by marling or draining.

The land in this county, as in many others, was formerly ploughed in high broad ridges, wherever the moisture could not readily sink through the subsoil. These ridges, so often described, were made by repeatedly ploughing towards the same line in the middle of the ridge. All the good soil was thus accumulated in the crown, and the deep furrows between the ridges were completely stripped to the subsoil. The consequence was, that much good soil was buried, and half the surface produced little or nothing. It was not an easy task to correct this and to lay the lands into neat and moderate stitches, so that the crown and furrow might alternately occupy the same line. It took some time to undo what many years had been employed in effecting, and some caution was required not to proceed too rashly in this reform. If the good soil of the crown were buried at once in the deep furrows, in order to level the surface, the crops would be very deficient. The only rational plan is to proceed slowly, forming a narrow stitch in the old furrows, and gradually widening it and raising it, till the old high stitch is divided into two moderate ones. Where the subsoil is porous, or the land has been efficiently underdrained, it may be ploughed flat without risk or danger, and the crop will be better and more equal.

The implements of husbandry now in common use in Oxfordshire are greatly improved. The old plough with a straight wooden turn-furrow and a pair of wheels in front, which, with four horses, scarcely ploughed three-quarters of an acre in a summer's day, is now seldom met with. But more horses are still used than strict economy would warrant, and the time occupied in labour is seldom more than seven or at most eight hours in the day, except in harvest. The walk of the horses and men is sluggish.

Thrashing-machines have been erected on many of the larger farms, but, from the great outcry against them, they are not in general use at this time on moderate-sized farms. The farmers prefer allowing their men to thrash by the task, as it keeps up a habit of industry and prevents their becoming idle when other work is slack. But if the time lost in thrashing by the flail were applied to draining, marling, or burning the soil, the increased crops would soon show whether machinery employed in husbandry to lessen manual labour be profitable or not.

Improved implements, such as scarifiers, grubbers, and drilling-machines, of various constructions, are used in most districts, having been introduced by some spirited proprietor or extensive farmer. If they are not always found so useful as the inventors of them would wish the farmers to believe, they excite reflections and comparisons which tend greatly to the improvement of the old mode of cultivation and to the economy of labour.

There are some large estates in the county, the property of noblemen and men of fortune, and a considerable portion of the county belongs to ecclesiastical and other corporations. These last, being let for terms of years or lives renewable at different periods, are not in general so well cultivated or so highly improved as where the leases are more certain. Short leases with restrictive clauses are common in some parts of the county, but these are very little more advantageous to either landlord or tenant than when the farm is held at will. It is impossible to prescribe a certain course of crops without destroying every chance of improvement in the system adopted.

The course of crops on the light loams is based on the Norfolk rotation, but generally with the addition of an extra crop or two after the wheat, such as beans and oats. Although this gives more crops of corn in the six years, it is very doubtful whether on any but the richest land it is equally profitable, except where there are meadows attached to the farm on which the proper quantity of stock can be kept to produce sufficient manure. Where mangel-wurzel, tares, or other crops for cattle or sheep, are taken instead of turnips in the recurrence of the fallow crop, the four years' course will in general keep the light lands cleaner and in better heart at the least expense. In the heavier soils which have been drained, or have a porous subsoil, the convertible system, having half the land in artificial grass and half cropped, is preferable; in that case the course is—turnips or other roots,—barley or oats,—clover and grass seeds, to remain three years or more,—wheat,—beans; the beans first, if the soil is heavy, and drilled so as to admit the hoe freely. The manure is given to the turnips abundantly. A small dressing on the grass, when it is ploughed up for beans, may be advantageous to the succeeding wheat crop; but if the grass has been fed off more than once with sheep, this will not be required.

The turnips were, till within late years, almost invariably sown broadcast. The hoers were expert, and the ground appeared well covered, if the turnips escaped the fly. Many farmers could not be persuaded to try wide rows and ploughing between them; but the example of some gentlemen and opulent farmers has much shaken the faith in broadcast turnips; and wherever the row culture has been once fairly adopted, especially in the heavier loams, it has in no case been abandoned. It is not the superior weight of the turnip crop alone which renders this method preferable, but the more perfect stirring of the soil and deepening of its staple when laid in narrow and high ridges. When the turnips are given to sheep on the ground, they are cut into slices or strips by a machine, and given in troughs, which is a great improvement on the old method of folding; and if they are carted off to the cattle-yard, the ridges give great facility to the carts, the wheels of which run in the furrows, as well as the horse which draws them. The introduction of the cultivation of mangel-wurzel, which is always in rows, has much diminished the prejudice against turnips in this way.

The corn crops are very generally drilled, and the hand-hoeing of wheat, just as it begins to tiller in spring, is gaining ground, and cannot fail to increase the average produce of this important grain.

On most of the stiff soils wheat is still most commonly sown on a complete fallow, and no doubt the finest crops are thus obtained. The only question is the expense. The land is cleaner, requires less manure, and is in better condition after the wheat, than if a crop of beans or tares had preceded. But a whole year is lost every fourth year, and less food is produced for cattle; consequently less manure made. If all this be taken into consideration, the advantage of greater intervals between the fallows will soon be apparent; the best farmers find it so. Where the land has been fallowed for wheat, very good crops of barley are produced after the wheat, and this practice, however much condemned by the modern rules of agriculture, has, notwithstanding, many abettors. Good wheat land will produce heavier barley than light turnip land; and hence it is asserted by some that barley is better after wheat than after turnips, but no one who has had any experience of this crop will assert this to be the case on the lighter and poorer soils. The finest barley grows on good rich land after a fallow without manuring, but this is too expensive a plan, as the same land would produce a much more valuable crop of wheat.

Beans are usually dibbled across the stitches. Women put them in by a line with a short dibble. They are generally put in too close: the rows are seldom above a foot apart, and the beans about three or four inches distant in the rows. This is proved by their often dibbling nearly a sack in an acre. The land is ploughed before Christmas, and the beans are dibbled as early as the weather permits; sometimes in January, and generally before March. They are hoed by hand as soon as they have four leaves. By having the rows across the line of ploughing, the ground is more easily cut with the hoe and laid level. A second hoeing is given when the beans are a foot high, and the weeds which rise in the rows are pulled out carefully by hand. To have the work well done costs from ten to twelve shillings per acre for the two hoeings; it is often done for less, but there is little saving in having it done imperfectly. It often depends on the care taken in hoeing the beans whether a crop of wheat may be obtained after them on a single ploughing or not.

Clover and rye-grass are usually sown among the barley, either separately or mixed. The rye-grass alone is admirable food in spring for ewes and lambs. The clover is usually mown for hay, and when the two are mixed, the hay is not only more readily made, but the crop is heavier; the rye-grass shoots above the clover plant and interferes very little with its growth. Rye-grass, however, must not be allowed to form its seeds, for in that case it impoverishes the soil, and the wheat crop suffers in consequence.

The cultivation of sainfoin on the chalky loams is one of the great resources of the farmers on such soils. Wherever there is chalk, sainfoin will thrive, and continue to yield both hay and pasture for many years. When it wears out at last, and is ploughed up, the soil is found greatly improved for corn. By means of sainfoin many a poor chalky farm has become profitable, and yielded a double and triple rent of what it did before. Its value is fully appreciated in Oxfordshire.

The meadows in this county which lie along the banks of the rivers are productive of excellent herbage; and the hay of some of the upland meadows cannot be surpassed. This may be supposed from the fertile nature of the soil in many places. There are scarcely any irrigated water-meadows. The old pastures, which have been in that state from time immemorial, and which many would think it a sacrilege to break up, produce rich butter and good cheese with proper management. But many of the pastures are neglected: rank weeds are allowed to grow in them, and ant-hills occupy a considerable portion of the surface. A little attention would make them much more productive. In some situations, where the soil is light and friable, and where the herbage is not of the finest quality, the plough, in spite of prejudice, would greatly improve them even if laid down again in a few years. The dread of not obtaining a good sward again is removed by the improved method of laying down arable land to grass; and the experience of the value of newly-sown pastures, when fed off at first, soon reconciles the farmer to the ploughing of old grass. Many a rich meadow has no doubt been ruined by ploughing it up and taking successive crops of corn, but this is the abuse of the system. Rich grass may be let alone, but that which is inferior may be improved by a course of arable cultivations. Within a reasonable distance of Oxford, and between that city and London, the fatting of calves, by allowing them to suck the cows, is preferred to making butter. The trouble and expense are much less. There is no milking nor churning: a man and a boy can manage twenty cows easily. In summer there are more calves suckled than there are cows; and as the milk falls off the proportion is lessened, till it requires two or three cows to fatten a calf. They are of ready sale when fat; and young sucklers, three or four days old, are readily purchased from the dairies. A calf eight or nine weeks old, which costs about twenty shillings at first, will sell for 4*l.* 10*s.* to 5*l.*, giving 3*l.* 10*s.* to 4*l.* for the milk it has sucked. This is a considerable produce from one cow in full milk. Butter would not produce so much; but the value of the porkers fatted on the skimmed milk, when added to the produce of the butter, will give more than this. A careful dairyman who attends to his business makes the most that can well be got from the cows. Suckling requires less attention, and is therefore preferred by many.

The farm-horses in Oxfordshire are mostly good and active; and if too many are often put together to a plough or waggon, they are the fatter and sleeker for it. If the farmer likes to spend part of his profits in having a team of fine fat horses, it is his concern; but if he prefer other comforts to the sight of a fine team, he may save a considerable portion of his expenditure, by making his horses do more work, and put out their whole strength. They must have plenty of corn inside, but not much fat on the ribs, to do a full day's work. The Oxfordshire waggons have nothing remarkable in them; they are light, and similar to the Berkshire. Single-horse carts, which are in general so much more handy and useful, are only used by a few of those proprietors and farmers who have laid aside old prejudices, and can appreciate improvements, from whatever quarter they may come. Light single-horse waggons, which have many advantages in some countries, are unknown in most parts of England: on a hard road they are even preferable to carts, both as to convenience and the load they will carry. The mode of feeding the horses in summer by soiling, chiefly with tares and cut clover, is very general, and to be commended. If the cows were kept in the stable during the heat of the day in summer, and in the cold nights of winter, more milk and butter would be produced, and the manure would well repay the trouble of giving them cut food. Some intelligent farmers have adopted this plan, and a very few feed the cows in stalls or sheds all the season.

The cows usually met with in this county are of various breeds, according to the fancy of the proprietors, some preferring the finely proportioned Devonshire cows, some the poor ill-shaped Alderneys, with their rich yellow cream. Some have cows of the old long-horned breed, but these are not now very common. The improved short-horns are now the favourite breed, both for the dairy and for calves: they fatten off readily, and always obtain fair prices. The small Ayrshire, than which a neater or more useful cow is scarcely to be found, is not very common, at least of the true breed; but those who have tried them, and reared them on the lands where they were afterwards to be fed, have had reason to be satisfied. They unite the qualities of the Alderneys and short-horns, and may probably be crossed with either, as rich milk or a good carcass is considered to be most desirable. It is a general observation in all dairies, that the cows bred at home are superior to those of the same breed brought from a distance. Most dairymen buy cows with their young calves, or ready to calve, and it is only the produce of some favourite cow which is reared now and then. These heifers having been well fed, winter and summer, from their birth, make fine cows, even if the breed be not the best. In the rich vale of the Thame the cows are chiefly of the short-horn breed, and purchased in calf at three years old. In these rich pastures they will thrive, wherever they may have been bred; but if they come from a rich country, and are transplanted on a poorer, they will not thrive so well. The short-horn breed is too large for a poor soil; the Ayrshire or North Devons are better in such situations. The latter are very good when they happen to milk well, but they often get fat at the expense of their milk. The Glamorgan cows are still in repute with some, but they are generally superseded by the short-horn and the Devon. For fatting calves, quantity of milk is of more importance than richness. In this respect the Teeswater breed is pre-eminent.

Arthur Young, in his 'View of the Agriculture of Oxfordshire,' reckons the average of butter made every week on rich pastures throughout the year at from 5 lbs. to 6 lbs. per cow. This will give from 260 lbs. to 312 lbs. per cow in the year, which is far above the highest average stated in any other county. We had occasion before to estimate the produce of a cow on very rich pasture in an adjoining county to be about 200 lbs. in the year, and we are inclined to adhere to that opinion. [BUCKINGHAMSHIRE.] If we suppose his calculation to be for nine or ten months only, the two results will approach more nearly.

There are some teams of oxen for the plough, but they become fewer every year. In spite of all that has been said and written on the subject, and the many calculations of the expense of cultivation with oxen compared with horses, which are in favour of the former, every spirited farmer takes the first opportunity of getting rid of his ox-team, and using horses instead. The sluggish pace of the ox is not suited to the taste of a man who strives to introduce economy of time and active progress in his work. It is enough for him to see two active horses walking briskly with one plough, while four heavy oxen creep on with another, to become impatient of the slowness of the oxen. The oxen are fatted off without working; and if this does not give so fine-grained beef, it puts more money into the farmer's pocket, which is an irresistible argument.

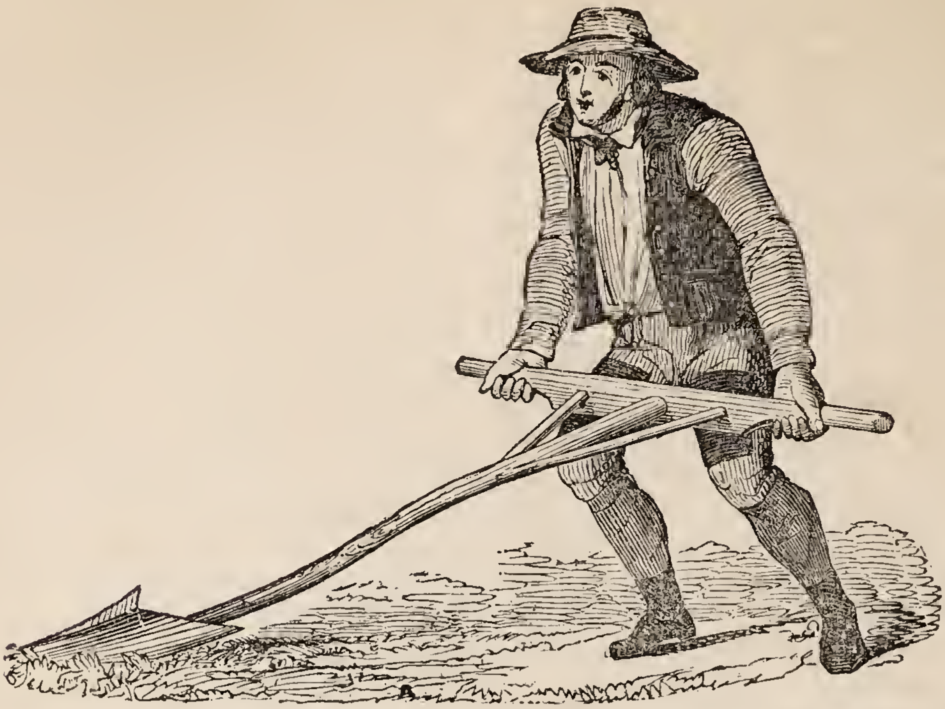
Sheep are an important object with the Oxfordshire farmer, and are in general well managed. The breeds are chiefly the Leicester and South-down, and crosses between these and the Cotswold, which produces a good sheep for some situations. The pure breeds seem however to be preferred. Where fine mutton and good wool are an object, the South-downs stand foremost: where quantity of meat and wool are to be obtained in a short time, and at the least expense, the Leicesters have the preference. On short grass the South-downs thrive best; in rich meadows the Leicesters. The increased cultivation of turnips increases the number of sheep kept and fatted. On a moderately light soil with a porous subsoil, the farmer will thrive best who can maintain and feed the largest flock of sheep on his arable land. The turnips and sheep are the basis of all improved cultivation of such lands. The raising large crops of turnips on ridges, and cutting them all for the sheep and lambs, will enable a tenant to live and realise a fair profit where, without these two improvements, he would scarcely be able to pay a moderate rent.

Large hogs are prized in Oxfordshire, where enormous boars are reared and fatted to be converted into brawn. But experience proves that a moderate-sized pig, which is prolific, and at the same time fattens at an early age, is much more profitable. A cottager will have a profit on fatting his small hog to ten score, while the farmer will lose money with a huge animal which attains twenty or twenty-five score when fat. A cross with the small Chinese improves almost every native breed, by lessening the size and producing more numerous litters.

PARING AND BURNING.—This operation consists in cutting a thin slice from the surface of land which is overgrown with grass, heath, fern, or any other plants which form a sward by the matting together of their roots. The sods are allowed to dry in the sun to a certain degree, after which they are arranged in heaps, and burnt slowly, without flame or violent heat. The result is a mixture of burnt earth, charred vegetable fibre, and the ashes of that part which is entirely consumed.

The object of this operation is twofold: first, to kill insects and destroy useless or noxious weeds completely; and secondly, to obtain a powerful manure, impregnated with alkaline salts and carbonaceous matter, which experience has shown to be a very powerful promoter of vegetation.

The instruments by which this is effected are, either a common plough with a very flat share, which may be used when the surface is very level without being encumbered with stone or large roots, as in low moist meadows; or, in most other cases, a paring-iron, which is used by hand. The crossbar of this instrument is held with both hands; and the upper parts of the thighs, being protected by two small slips of board, push the instrument into the ground, so as to cut a slice of the required thickness,



which is then turned over by moving the cross-handle. The labour is severe, and a good workman can scarcely pare more than one-sixth of an acre in a day. The price of this work is from 15*s.* to 25*s.* per acre, according to the price of labour. The drying, burning, and spreading of the ashes are contracted for at from 10*s.* to 15*s.*, or more: thus the whole cost is from 25*s.* to 2*l.* per acre. In France it is done by a *cob*, which is like a shipwright's adze, and the operation is called *écobuer*.

Paring and burning the surface is an almost invariable preliminary in the converting of waste lands to tillage; and where these lands are in a state of nature, overrun with wild plants which cannot be easily brought to decay by simply burying them in the ground, burning is the readiest and most effectual mode of destroying them. In this case the practice is universally recommended and approved of.

But it is not only in the reclaiming of waste lands, and bringing them into cultivation, that paring and burning the surface is practised. The fertility produced by the ashes, which is proved by the luxuriance of the vegetation in the first crop, has induced many to repeat this process so often as materially to exhaust the soil, and induce partial sterility. Hence the practice has been recommended on the one hand, and strongly reprobated on the other.

When we come to apply to the subject the test of experience, and reason correctly on the facts which are presented to us by the abettors of the practice and its adversaries, we shall find that the advantages and disadvantages arise chiefly from the circumstances under which the operation is carried on. But it may be necessary to an impartial examination of the subject, to inquire into the changes produced on the substances subjected to the process of burning, when it is done with due precautions.

In burning vegetable matter in an open fire, the whole of the carbon is converted into carbonic acid and flies off, leaving only some light ashes containing the earthy matter and the salts which the fire could not dissipate. These are no doubt very powerful agents in promoting vegetation, when they are added to any soil: but they are obtained at a very great expense of vegetable matter, which, by its decomposition in the earth, might also have afforded food for vegetation. If the earth which is burnt with the sods is of a cold clayey nature, the fire will change it into a kind of sand, or brick-dust, which is insoluble in water, and corrects the too great tenacity of clays, by converting them more or less into loams. This is so well known, that clay is often dug out of the subsoil to be partially burnt. On stiff clay soils therefore there is a double advantage in paring and burning, that of the vegetable ashes and of the burnt clay. When the fire is so managed that the vegetable matter is only partially burnt, the oily and inflammable portions being converted into vapour by the fire without being destroyed, and absorbed by the earth, the effect produced is only to impregnate the earth with minute particles of matter, readily converted into the constituent parts of vegetables. The earth is the mere recipient of these particles, which are held in its pores, as water is in a sponge, ready to be let loose to any substance which has the power of attracting them. The moisture, which the dry earth will also absorb from the atmosphere if no rain should fall, is retained and increased by the effect of the salts with which it is impregnated. It is uniformly observed that turnip-seed, which in most soils will not vegetate without heavy dews or rains, if sown in dry weather, scarcely ever fails to spring up in the ashes of a soil that has been pared and burnt. May not this be ascribed to these particles, which have been taken up by the earth in the operation of slow combustion, absorbing moisture from the air, and giving it out to the seed which has been sown? It does this better than a heavy shower would: a heavy shower soaks the ground for a short time, and swells the seed: but, if it be succeeded by a hot sun, the water evaporates so rapidly, that the seed loses its moisture, and vegetation stops. The earth, which attracts moisture from the air, keeps it, its absorbent nature preventing the evaporation; and it furnishes it gradually to the vegetating seed as it is required. The wonderful effect of peat-ashes on young clover may be explained on the same principle, and probably also that of gypsum. There can be no doubt then, that considerable advantages may result from the operation of paring and burning the surface of clays. But what is lost and destroyed in the operation? All that escapes in the shape of gas or vapour. The gas will probably be carbonic acid; for this is formed by the combustion of charcoal. We know that hot lime has a very strong attraction for this substance, which it fixes in a solid state, becoming a carbonate of lime: and we have no reason to think that it parts with it to the roots of plants. But other earths may absorb carbonic acid, without having so great an attraction for it, and let it loose to water, with which it is known to combine in certain proportions, and to be thus carried into the vessels of growing plants by the attraction of the roots. If this should prove to be the case, we may account for the great effect of burnt sods in promoting vegetation.

The principal objection to burning is, that it destroys a great portion of vegetable matter. But this is a fact to be proved, and is perhaps rashly taken for granted. When vegetable matter decays in the earth, it loses much of its substance, which is converted into volatile matter, and flies off into the atmosphere. It is possible that thus more is lost during the time that the slow decay goes on, than even in burning with due precautions. This is a fact which it may be difficult to ascertain; but it is not impossible: and therefore the assumption of the contrary requires to be founded on some proof or experiment. The earthy portion of the soil may be diminished, by driving out the water which it held, as is manifest in burning clay, and it shrinks into a smaller space; but there is as much earthy substance as before, and this substance is improved by the burning. It appears then, that a clay soil may be pared and burnt, without its real substance being diminished; and if its texture is improved, it becomes more fertile by the operation.

Burning clay soils is in fact something analogous to liming. Lime dissolves the vegetable matter, and enables its elements to enter into new combinations: but if no new vegetable matter be added to restore what is exhausted by vegetation, liming, as well as paring and burning, is detrimental in the end. Many experienced farmers pare and burn the soil on the edges of their ditches and on the banks on which the hedges grow, because they thereby exterminate many rank weeds; and the burnt earth mixed with farmyard dung makes an admirable compost. Here the burnt earth acts as an absorbent, and no doubt attracts many of the volatile parts of the manure, which are produced by the decomposition of animal and vegetable matter in it. Paring and burning therefore should be joined to manuring, if a powerful and immediate effect is desired without exhausting the soil; and in this case we do not hesitate to recommend it on all cold clay soils where rank weeds are apt to spring up, and coarse grasses take the place of the better sorts which have been sown. The proper time to pare and burn is evidently after the land has lain in grass for several years, and is broken up for tillage. The surface should be pared thin; about two inches is the extreme thickness allowable for the sod if the soil is very stiff and poor, and as thin as possible in a better soil. It should be done with a breast-plough or paring-iron by manual labour. The sods should be moderately dried, and then arranged into small heaps with a hollow in the middle to hold heath or bushes to kindle the fire. When it has fairly established itself, all the apertures should be carefully closed. Wherever any smoke breaks out, a fresh sod should be immediately put over it; a heap containing a small cart-load of sods should be smouldering for several days without going out, even if it rains hard. If the fire is too brisk, the earth will form hard lumps, and even vitrify; but otherwise it comes out in the form of a fine powder, in which evident marks of charcoal appear. If this is of a fine red colour, it is a good sign; for the iron in the earth has been converted into a peroxide, which is perfectly innocent in its effects on vegetation, whereas all the saline impregnations of iron are more or less hurtful. It is better to burn the sods in large than in small heaps; for the more the fire is smothered, the better the ashes.

So great a quantity of ashes is sometimes produced as to admit of a portion being carried off on grass land, or used to manure another field for turnips. As this is evidently robbing the field where the operation has been carried on, an equivalent quantity of manure should be brought in exchange. Perhaps the most advantageous mode of using the ashes is to spread them in the drills where the turnip-seed is to be sown, after a portion of dung has been buried under them. In this manner the ashes from one acre of land pared and burnt, together with ten or twelve cart-loads of good yard dung, will manure two acres, and all the manure of one acre, in the ordinary mode of raising turnips on ridges, will be saved. If the ashes will produce as good turnips with half the usual quantity of dung, the expense of paring and burning is amply repaid. But experience proves that the earth and ashes almost ensure a good crop of turnips in many poor stiff soils in which they would probably not have succeeded if sown in the common course of cultivation without bones or ashes.

When a considerable extent of poor land is brought into cultivation, and there is no sufficient supply of manure at hand, paring and burning a portion of the land every year, by which a crop of turnips is obtained, is a most effectual means of improvement. Lime may be used at the same time with the ashes, and will increase their effect, provided some vegetable undecayed matter remains in the soil after paring; but lime will tend to exhaust this; and if, in consequence of liming, a few good crops of corn are obtained at first, the soil will be so exhausted as to be of little value afterwards. This is the abuse of the practice which has caused it to come into disrepute. It would be a great waste to burn the surface of a rich piece of grass land where the plants growing in it are tender and succulent, and would readily rot on being ploughed under; in such case a moderate application of lime would have a much better effect. This kind of land will produce good crops without any manure, and continue fertile for many years if judiciously cultivated. To pare and burn rich land is wasteful, and can never be recommended. It is only on poor land which has not strength to produce a crop, and of which the texture requires to be improved and its powers stimulated, that paring and burning is advantageous; on poor thin chalky soils which have been laid down with sainfoin, of which the roots and stems are grown coarse and hard, so as not readily to rot in the ground, the operation is proper and advantageous. The turnips produced by the ashes, with or without the assistance of dung, must be fed off by sheep folded on the land, whose dung and urine will enrich it, and their tread consolidate it. By this mode of proceeding great advantages are obtained from paring and burning, and the land, so far from being deteriorated, will be improved.

Many landlords rigidly forbid their tenants to pare and burn any part of their land, from an idea that the heart of it is destroyed by the burning. If they would only insist on a certain quantity of dung being put on, either at the same time that the land is thus treated, or for the next crop, and prohibit the sowing of corn crops except after turnips, clover, or some other green crop consumed on the farm, there would be little danger of any detriment to the land, even if it were pared and burnt once in every ten or twelve years, provided it were judiciously treated in the intervals. The farmer would be benefited in many situations, and the practice would tend to keep up the value of the farms.

In Devonshire, where the land has been pared and burnt from time immemorial, even where the soil is rich, the practice has been often resorted to without any judgment. Provided a crop of corn or potatoes was obtained at little cost, the consequences to the future state of the land were not heeded; and landlords, seeing their farms impoverished, put a stop to the practice. Thus many useful modes of cultivation have been reprobated from the abuse of them, which, properly applied, would have been advantageous to all parties. There is no maxim more true than this: that whatever injures the landlord, injures the farmer who is not desirous of removing, and *vice versâ;* and all positive restrictions on cultivation, however necessary when there is a fear of dishonest conduct, diminish the value of a farm and lessen the rent which can be fairly afforded for it. Ignorance is often a greater destroyer of the interest of both landlord and tenant than wilful dishonesty; and the spreading of useful information amongst tenants, so that they may see their own advantage, is the surest means of improving landed property. Many tracts of waste land might be brought into cultivation by means of paring and burning, which without it would never repay the labour required. Where the soil is inclined to peat, this operation and abundant liming are the indispensable preliminaries of cultivation. The ashes and the lime will produce vegetation and food for animals. These will produce dung to supply what the vegetation abstracts, and to assist also in the further decomposition of the peaty matter, converting it into vegetable mould.

The first crop after paring and burning, as was observed before, should, if possible, be turnips, and these should be consumed on the spot; but there are exceptions to the rule. The soil may be a stiff clay of a considerable degree of natural fertility, only encumbered with rank weeds and grasses. In this case the surface is burnt to destroy these, and a crop of corn may safely be taken after the paring and burning, the land coming into a regular alternate rotation after it. For example, the next crop may be beans or tares, with a good proportion of dung; or clover may be sown with the first crop, if the ground appears fit for it. The effect of the ashes will be readily perceived in the luxuriance of the clover. Such land may be afterwards cultivated, according to its nature and quality, with the rest of the farm; or laid down to grass after a course of cleansing and ameliorating crops. Thus old wet meadows, after having been well underdrained, may be greatly improved, and either converted into arable fields or laid down again with choice grasses.

Old rough pastures may often be greatly improved by a very thin paring and burning, so as not to destroy all the roots of the grass. When the ashes are spread over the pared surface, some good grass-seeds are sown with them. The whole is well harrowed or scarified and rolled, and the grass which will spring up after this will be greatly improved, and will fully repay the expense of this simple mode of renovating it. This is the cheapest mode of improving coarse pastures that we know, without breaking them up.

The partial paring and burning of the headlands of fields, for the purpose of mixing the ashes and burnt earth with dung in a compost, is a most excellent practice, and often superior to that of using the sods only, without burning them. These sods contain innumerable seeds of weeds, and eggs or maggots of insects, which are not destroyed by the fermentation of the heap, but, on the contrary, are brought to life. The loss of a portion of vegetable matter in the burning is amply compensated by the destruction of these enemies of the future crops.

It now only remains to take notice of the soils and situations where paring and burning cannot be recommended. Wherever the soil is very loose from a great proportion of silicious sand in its composition, and is held together chiefly by the slender roots which run through it, the burning would destroy the whole of the vegetable matter; for none of the volatile parts which the fire dissipates or generates would be retained or absorbed, but would pass through the loose sand in the same way that water would. Here then would be actual destruction; and the residue would be a mere barren silicious sand, much worse and more porous than it was when held together by the roots. The only way to bring such soils into cultivation is to put clay or marl on them, and to force vegetation by means of liquid manures, chiefly the urine of animals, consolidating them by every means applicable, so that they may retain moisture, and that the manure may not be washed through by the rains. Such soils may be improved, but they are the most ungrateful of any; and it is only necessity and indefatigable industry which can make them produce any crops.

It is very easy to ascertain whether any soil will be improved or not by paring and burning. A few sods may be taken and exposed to heat in an iron pot closely covered over, or in a large crucible: the heat should not be so great as to produce light, but should be kept up for a considerable time, till the sods are consumed. If the ashes are red, and the whole is a fine powder, with particles of charcoal in it, the soil from which it was taken may be safely pared and burnt, especially if it forms a mud with water, and the earth is not readily deposited. But if it feels gritty, lets the water readily through, and is soon deposited when mixed with it, burning will not be advantageous. This is the evident result of the principles laid down before.

On the whole, the operation of paring and burning, when judiciously applied and properly performed, is a most excellent and cheap improvement of certain soils, and it will never diminish their fertility, if they are properly cultivated and manured, and a judicious succession of crops is adopted; but on the contrary it will improve their quality and texture, and make them more productive.

PASTURE LAND.—There are tribes which have no other occupation than that of pasturing domestic animals, and immense tracts of fertile soil are still unappropriated to any definite owner. Where the climate is genial, and the extremes of heat and cold are unknown, cattle are fed all the year round by moving from one place to another. In such a state are some of the wandering tribes of Asia, who have no fixed habitations, but pitch their tents wherever pasture is abundant, and move them to another spot as soon as it is consumed where they are. In civilised countries, where the land is divided and appropriated, such a system cannot exist; though there are still traces of it in this country, as we see in the few remaining waste lands on which there is a right of common.

The pasturage of cattle is now a part of regular husbandry; the land which affords the herbage for cattle forms part of private possessions, and a rent is paid for its use. This has introduced a new system. Pastures are now fenced and protected, and pains are taken to improve them, so as to maintain many more cattle or sheep than they would in their natural state. We shall not here speak of rich grass lands, in which bullocks and sheep are fatted, and which are commonly called grazing land; nor of artificial pastures, which form portions of arable farms, and have been depastured only to enrich them and make them more fit to produce corn when again submitted to the plough. But we shall consider those tracts of land which, from situation, climate, or other causes, although they are portions of certain estates and the property of individuals, lie nearly in a state of nature, and produce a revenue or profit only according to the number of cattle and sheep which can be reared or maintained in them. Such are the rich pastures on the Jura, the Alps, and Pyrenees, too high and exposed to allow of cultivation or permanent habitation, but producing abundant food for cattle in particular seasons of the year. The Jura and the Alps, which are best known to English travellers, contain very rich pastures for cows, and give a considerable return in butter and cheese. The snow which covers these mountains for a considerable part of the year, protects the herbage; and the moisture which prevails in the summer by the continued passage of clouds, which appear in the form of heavy fogs to those who are enveloped in them, keeps up a luxuriant vegetation of the small Alpine plants which form the richest pasture.

Whenever pastures are hired, the rent is always reckoned, not by the extent of surface, but by the stock which can be maintained upon it. Thus, in Switzerland, the mountain pastures are divided into portions of twenty, forty, or more cows. In Scotland they reckon sometimes by the number of bullocks which can be reared, and sometimes by the number of sheep which can be kept. This mode of reckoning is much fairer than by mere extent of surface. In many places pasturing has been found much more productive than cultivation; and some large proprietors have converted great tracts of land from arable into pasture farm. But this can only be done where the population is very scanty, and where the soil and climate do not tempt men of capital to settle.

Considerable improvements have been made in natural pastures, not only by the raising of banks and stone walls as shelter against the winter's storms, but also by extensive draining and clearing the surface of wild plants and shrubs, which prevent the herbage from springing up, and greatly diminish the feed. On the sides of steep hills, where springs are apt to break out and produce bogs and swamps, drains judiciously made have carried off the water and laid dry the pastures below them; while reservoirs have been constructed in many places to receive the water and to supply the stock in dry weather. On peaty moors the application of lime to the surface has often produced wonderful effects, and made various kinds of clover and grasses spring up which were never seen on the spot before.

Those who are possessed of extensive pastures, often look upon them as of too little value to lay out any money in their improvement; and unless when an attempt is made to bring them into regular cultivation, which often fails after a great outlay of money, they are not thought worth any attention. Yet many rough hilly pastures might be doubled and tripled in value merely by clearing the surface, burning coarse grasses, rushes, ferns, and furze; and sowing a few seeds where the ashes have been spread. The additional number of cattle or sheep which can be maintained by this means, would surprise any one who had not had experience of such improvements. The forming of convenient channels for the water to run off is another important object, which can often be effected at a trifling expense; and a loose surface laid dry by this means may be much improved, by merely burning the heath which grows upon it. After the fire has scorched the ground, grasses will spring up spontaneously: and, at a very small expense, a considerable tract of mountain pasture may be converted from the state of a brown heath or moor to that of a fine green sward.

Wherever there are large pastures, proper and suitable buildings made of substantial materials should be erected. The cattle should have numerous sheds for refuge in bad weather, and sheep especially should have protection and shelter. Warmth is in some cases of more importance than food: and an animal exposed to all the severities of a northern climate requires more food to keep him alive, than when he is kept warm and protected from the immediate influence of cutting winds.

There is another kind of pasture in England on the chalky hills which are called downs, where useful and hardy sheep are reared. Here the exposure is less, and the proximity to the plains gives frequent opportunity of driving the sheep to sheltered situations. The grass on the chalk hills is in general very fine and short, and the quality is very good. The soil is only a few inches deep, but it has been enriched by the dung and urine of sheep from time immemorial. Attempts are made occasionally to convert some portions of these pastures to tillage: but it is not often an advantageous speculation. A few crops may be obtained at first; but the thin layer of rich earth, which is at the surface, is soon exhausted, and nothing remains but barren chalk. No art can restore the fine turf which had been produced by ages of pasturage.

To those who have extensive pastures it is of great consequence to ascertain whether oxen, heifers, cows, or sheep are the most profitable, and of these, what breeds suit the situations; and, when this has been determined by experience, to know what quantity may safely be kept, without suffering for want of sufficient food, or allowing any portion of the pasture to wither or become coarse from not being duly fed off. Whatever be the stock depastured, the greatest attention should be paid to them by a herdsman or shepherd of experience, who should have a certain number only under his care. It is a good plan to give him some share or interest in the produce as part of his wages. When any part of the stock is sold off to drovers or butchers, he should have a per centage on the sale. This will give him the activity of an owner, and he is not so likely to be negligent and allow the stock to suffer from a want of sufficient food, or from accidents which can be prevented by proper attention.

Very poor pasture on sandy or gravelly loams is of very little value to the proprietor; where the situation allows of such land being converted into plantations, it will generally be found most advantageous to do so, but if there are means of improving them by ploughing, liming, and manuring, they may often be converted into good arable farms. A great part of Norfolk, which now bears excellent crops of barley, wheat, and clover, was once only poor sandy pasture, where the chief income to the proprietor arose from rabbit warrens. We must not always judge of the capabilities of a soil by the natural grasses which grow upon it, before it has ever been stirred and cultivated. When loamy sand or gravel is left in a hard condensed state, it will bear very little, but when it has been broken up deep, and trenched and improved by lime and manure, it becomes very useful land. The same may be said of cold wet pastures on a stiff clay. The water checks the roots of the better sort of grasses, and nothing thrives in such pastures except rushes and very coarse aquatic plants; but when they have been carefully drained—when the surface has been pared and burnt, and the ashes spread over the land—a very material improvement takes place, whether it be left unbroken, to produce herbage, or be improved by a course of judicious cultivation, and laid down again to grass in a clean and fertile state; in either case, the pasture, from being of little use, and perhaps dangerous for sheep, which are apt to rot there, becomes sound and good, producing excellent nutritious herbage, and will continue so ever after.

When the soil is naturally deep and of a good quality, but the situation renders it not advisable to convert the pastures into permanent arable land, and the herbage has been deteriorated and overrun with moss or weeds, it is a very effective mode of improving the pasture to plough up the sward as thin as possible, and then, having removed the sods into heaps or rows, to plough and scarify the bared surface to the depth of four or five inches, so as to give it the appearance of a fallow field. When it is well pulverised and harrowed level, the sod, which had been taken off, is chopped into small pieces by the spade, and scattered over it; and after a shower has somewhat moistened the surface, it is well rolled with a heavy roller. Thus the moss is effectually destroyed: the root-weeds have been eradicated, and the fine grasses, the roots of which are short and fibrous, are preserved. They will soon strike into the loosened soil, and a fine close sward will be the result. The improvement is still greater if lime is put on the land before the spreading of the sods, and if at the same time some of the best grass-seeds are sown over it. The proper season for this operation is after harvest, and no cattle should be admitted till the next spring.

Pastures are seldom improved with manure, which is generally reserved for arable land, or grass land intended to be mown for hay: but if richness is valuable in a pasture, it will well repay the expense of manuring, especially with liquid manure, the drainings of dunghills and the urine of cows and horses, which is collected in a tank when they are kept in stalls. Peat ashes are also very useful, and have a powerful effect in stimulating the vegetation of all the grasses. Saltpetre and nitrate of soda are said to have the same effect. When it is intended to convert land which has been in a state of heath or waste, covered with fern, brambles, ling, and other coarse plants, into good pasture, it is indispensable to begin by a course of arable cultivation; and it is only when the soil has been brought into an improved state by tillage and manuring, and all the roots and seeds of noxious plants have been eradicated, that grass-seeds may be sown with any prospect of obtaining a good sward. Most of these soils are poor and sandy, and not very favourable to the growth of good grass. In this case the safest mode of converting the land into pasture is by inoculating it with pieces of sods taken from a good rich pasture. [Grass Land.] By this means, and subsequent depasturing with sheep only, very good pastures have been produced on very poor soils; and if in the course of a few years they should degenerate, they may be profitably broken up and cultivated on the convertible system of husbandry, after which they may again be laid down for a certain number of years. Wherever the soil consists of a sandy or gravelly loam, this system is the most advantageous.

In the richest pastures, such as those of Lincolnshire and other grazing counties, an acre will maintain and fatten an ox of eighty or ninety stone, and sometimes keep several sheep in store order besides. There is a marked difference between land that will fatten an ox, and that which will only rear him. This can scarcely be discovered by simple examination of the land; but is found by experience. The same appearance of grass has more *proof*, as it is called, in one place than another. The bite may be very short and the pasture appear bare, and yet the value of it may be seen on the ribs of the cattle. Much of the skill of a grazier consists in stocking his pastures to advantage. He should know the power of every portion of it, and stock it so that the grass may not grow faster than it can be cropped by the cattle or sheep, and that the animals may always have the full quantity required. Every animal wants a certain quantity of food to repair the daily waste occasioned by the animal functions. If he has no more, he makes no progress: the more he can convert into flesh and fat beyond this quantity in a given time, the more profitable he will be. Hence the superior qualities of some animals with respect to this point indicate the superiority of their breed, and afford the greatest net profit to the grazier. In the same pasture one beast or sheep will give a reasonable profit, while another may occasion an actual loss. The adaptation of the stock to the nature of the pasture is consequently an object of the greatest importance, and requires much judgment and experience.

PEA. The garden pea (*Pisum sativum*) is a native of the south of Europe, but sufficiently hardy in a young state, or when its development is not much extended, to bear our winters when they are moderate, and when the plants have, as in gardens generally, a sheltered situation.

The pea, together with the bean and kidney bean, are enumerated as the legumes cultivated by the Romans; and these indeed comprise the principal species of leguminous plants in the kitchen-gardens of Britain at the present day. Among these the pea ranks first in importance and general usefulness. It had probably been introduced into this country at an early period, for peas are mentioned by Lydgate, a poet of the time of Henry VI., as being hawked in London. It appears however that for at least a century afterwards, in Queen Elizabeth's time, they were either not very common, or the manner of obtaining them early was unknown, for Fuller states that in the last-mentioned reign peas were brought from Holland, and were accounted "fit dainties for ladies, they came so far and cost so dear."

The varieties of the pea are numerous. The best account of them will be found in the 'Transactions of the Horticultural Society,' 2nd series, vol. i., where 43 varieties, comprising no fewer than 175 synonyms, are arranged and described.

The following is a selection of the more useful varieties:—For early sowing—

Early Dwarf.
Early Frame.
Early Charlton.
D'Auvergne, a particularly excellent sort.

For the principal summer crop—

Blue Prussian.
White Prussian.
Groom's Superb Dwarf Blue.
Dwarf Green Marrow.
Knight's Dwarf Marrow.

For late sowing—

Knight's Tall Marrow.

There are some varieties of peas destitute, or nearly so, of the internal tough lining of the pods; these are called *sugar peas,* and their pods are eaten cooked in the manner of kidney beans. The best variety of this class is the Large Crooked Sugar, which will likewise be found a very good sort for use in the ordinary way.

The soil for peas ought to be fresh and well stirred, but not too rich; for in the latter case a luxuriant growth is induced without fertility.

The times of sowing are, in November for the earliest crop, and at intervals of a month, three weeks, or a fortnight, as the season advances, till Midsummer. The produce from any that may be sown after this period is very uncertain; as is indeed the case with the November and other sowings previous to those of spring. The shelter afforded the young plants in winter by spruce branches or temporary awnings is of course beneficial. Various plans have been suggested for forwarding peas under glass, so as to transplant in the end of February or in March into the open ground. The best mode is to sow in small pots, and at the proper season to turn out the plants with the ball of earth and roots as entire as possible, to plunge them at short intervals in rows, and to shelter them by sticks of a branching nature and fan form.

The distance which should be allotted for the intervals between the rows of peas may be three, four, five, or six feet, according to the growth of the sort and richness of the soil. The plants should not be allowed to grow too thick in the rows, otherwise they are drawn up slender, without a due proportion of foliage on the lower part of the stem, which, in that case, as well as the leaves depending on it, is apt to become unhealthy and to mildew.

Agricultural Cultivation.—The common pea is a vegetable too well known to require description. It is cultivated in the garden and in the field, and there are several varieties of it. The plant is naturally a creeper, having numerous tendrils, by which it lays hold of stronger plants and supports itself. The pods contain one row of round seeds, which at first are soft and juicy, in which state they are used for the table under the name of green peas. They afterwards harden and become farinaceous, and the stem dries up. In this state they are thrashed and stored for use like corn, and serve chiefly to fatten hogs. The straw is given to cattle and sheep in winter.

There are some varieties of peas the stems of which do not rise or creep, but remain short, and hence are called dwarf peas. These are preferred for early sowing in the garden, and likewise when they are cultivated in the fields to be gathered in a green state. Every gardener strives to raise early peas, and the first which are brought to the London market are sold for a very great price. As soon as they are more common, such quantities are sometimes raised in the fields, that the price scarcely defrays the expense of gathering and bringing to market. When the market is not overstocked, this crop is very profitable, as it does not exhaust the land, and there is good time for a crop of tares or turnips after the peas in the same season. But the usual purpose for which peas are cultivated in the regular course of husbandry, is to fatten hogs. A white sort, which readily splits when subjected to the action of millstones set wide apart so as not to grind them, is used in considerable quantities for soups, and especially for sea stores. There is also a blue sort which answers the same purpose. The hog pea is of a grey or dun colour.

Peas contain much farinaceous and saccharine matter, and are therefore highly nutritious; no other seed surpasses them in this quality, except the seed of the French bean (Phaseolus). But this is refused by most animals in the raw state, owing to a certain toughness, which makes them adhere to the teeth; and, even when boiled, they are not relished by them.

As food for hard-working men, peas are excellent when well boiled and mixed with some animal fat, or the liquor in which bones have been long and slowly boiled to extract the gelatine. In some countries peas-meal is baked into hard cakes, with or without oatmeal or barley-meal. These cakes are nutritious, but are of difficult digestion, except where custom and hard labour have inured the stomach to their use.

The soil best suited to the growth of peas is a light or sandy loam of some depth, and in good heart: the usual preparation of it is by repeated deep ploughings and pulverising with harrows or other instruments. It is not advisable to manure the land immediately for peas, as it makes them throw out abundant stems at the expense of the produce in pods. They follow well after barley in which no clover has been sown, and are a good substitute for clover where there would be a danger from the too frequent repetition of clover on the same land. When clover has failed, peas supply its place, the ground being ploughed up before winter, or early in spring, and well pulverised. The wheat is not always so good after peas as after clover, when the clover is a good crop; but it is well known that if the clover fails, the wheat will also suffer. It is therefore better to have peas than to risk sowing wheat after a thin crop of clover. If the peas are not well hoed, and do not cover the surface, the land will be full of weeds; but with good management it may be looked upon as a cleansing crop. Many farmers consider peas as a very uncertain crop; but they are only so when the land is carelessly cultivated. They are, no doubt, often injured by want of moisture in the soil, or by an excess of it; but deep ploughing will prevent the former, and careful draining the latter. If peas are sown on land which is exhausted, or naturally very poor, no certain crop can be relied on. It sometimes happens however that an excellent crop is obtained against all probability, considering the state and tillage of the land, owing to some fortunate coincidences of favourable weather; and in this case it would appear as if great care in the preparation of the soil were unnecessary: but this is not often the case, and no prudent farmer will trust to the chances, which are much against success. In nine cases out of ten a slovenly cultivation or an improper succession of crops is the cause of great disappointment and loss, and it may be laid down as a general rule, that no good farmer will trust to accident, when by a little care and attention and a reasonable expenditure he may almost ensure success.

Peas must not be repeated on the same land in less than 10 or 12 years, nor are they to be recommended on very stiff clays, on which beans are to be preferred. Wherever beans suit the soil, they are a much better preparation for wheat than peas, admitting of much more frequent and perfect hoeing, besides the application of an abundant coat of dung, of which the wheat reaps the benefit as well as the beans.

Peas should be sown as early as the ground will admit of being worked; and in very mild winters January is a very good time for sowing peas, which are intended to be gathered green, in a sheltered situation sloping towards the southwest. The hog peas may be sown in February or March; and if they are horse-hoed, and the earth is raised against the young plants, they will not suffer from a moderate frost. When peas are drilled at two feet or more between the rows, it will not take above two bushels to drill an acre. The old method of sowing peas broadcast and ploughing them in is now seldom practised, and to sow them and harrow them in is nowhere recommended; the birds in this case having much too great a share of the seed. When peas follow clover, the practice of dibbling them into the sward, which has been turned over with the plough, is much to be preferred. Wherever dibbling is generally practised, and there are sufficient hands to put the seed into the ground in a reasonable time, it should be preferred for every kind of crop that can admit of the hoe in the intervals.

When peas are sown later than usual, it is useful to steep the seed a few hours, in order that it may vegetate sooner. A week may often be gained in the coming up of the crop by this means.

The Everlasting Pea, which is so well known in our gardens, has been recommended to be cultivated in the fields for green fodder for horses, which are said to eat it readily. In land which has been well manured, it will produce a very great weight of green food; and there are probably varieties of it more succulent and sweeter than others. If it could be established in a field, it would produce abundant food for several years in succession, without any other cultivation than hoeing out the weeds and stirring the soil around the plants. The seed should be sown in rows, and the plants thinned out by the hoe, so as to stand a foot or 15 inches apart; they would then have room to grow out, and would cover the ground completely. By transplanting year-old plants, a still greater crop might be obtained. It is at least worth a trial.

Peas should be drilled in rows at such a distance as to admit the horse-hoe between them. They should be horse-hoed repeatedly until the stems are so long as to fall down and cover the intervals: a slight earthing of the rows with a plough has the effect of keeping the stems from the ground and allowing the air to circulate under them, by which the podding is much encouraged; for in wet seasons the stems are apt to lie on the wet ground and to rot. When the seed is ripe in the pods on the lower part of the stalks, the crop should be reaped, or many of the pods will burst, and the seed be lost. The reaping is performed by pulling the straw from the root by hand, or by means of two reaping-hooks, which partly tear up the stems, and partly cut them off. They are then gathered into small loose heaps, and left to dry. After being turned over till they are quite dry, they are carted to the stack or barn. Unless the quantity be considerable, so as to make a large stack, it is advisable to put them in a barn, because they are generally thrashed out soon after harvest, when the hogs, having run for a time in the stubbles, are put up to fatten. When the peas are stacked, many of the pods are necessarily exposed to the depredation of birds; and, if they escape this, they burst, and the seed is lost.

The produce of an acre of good peas is from 30 to 40 bushels, and the price somewhat higher than that of beans. They are consequently a profitable crop, and will well repay a little attention in the cultivation. If the land is not in sufficient order and heart to make it advisable to sow wheat after the peas, barley or oats may be advantageously substituted. If the peas fail, it may be necessary to clean the land with a fallow crop before any other corn is sown, for a bad crop of peas invariably leaves the land foul.

The straw or haulm of peas, when well harvested, makes excellent fodder for cattle, and especially for sheep, which are very fond of the dry pods when the seeds have been thrashed out.

In some places, they sow peas and beans together broadcast, and plough them in; the beans serve as a support to the peas, and a greater return is expected; but unless it be for the purpose of cutting them up for green fodder, as soon as the pods are formed, this practice is not to be recommended. In Flanders, peas, beans, tares, and barley are sometimes sown thick together, and form an abundant green crop, which is cut as soon as the flower is past, and given to the cows and pigs, which thrive well on this succulent food. The surface of the ground is so completely shaded, that no weeds can spring up; and as there has been no seed formed, little is taken from the soil. The land is immediately ploughed up, and sown with another crop, such as potatoes or turnips, which sometimes are off the ground in time to allow wheat to be sown the same year.

PEAT is a substance of vegetable origin, found wherever the soil has been long soaked with water which has no outlet and does not completely evaporate by the heat of the sun.

When dried peat is examined, it is found to consist of roots and fibres in every stage of decomposition, from the natural wood to the completely black vegetable mould. From the nature of its formation under the surface of water, it acquires a portion of tannin, which has the property of preserving animal and vegetable matter from decomposition. Hence large branches and trunks of trees are found imbedded in peat, which have no mark of decomposition, except what may have taken place before the wood was completely immersed in the peat. Peat contains all the elements of the richest manure, and may by an easy process be converted into humus: for this purpose the agency of alkalis is the most effectual. If the tannin be decomposed, that of the vegetable fibre will go on, and soluble humus will be formed. When peat is newly dug up, if caustic lime be added to it before it is dry, the moisture of the peat slakes the lime, which acts on the gallic acid in the peat and neutralises it. If this mixture be then excited to fermentation by the addition of animal matter, such as urine or dung, oxygen is absorbed and carbonic acid evolved; and the residue is converted into an excellent manure, containing much soluble humus. The same may be effected more slowly by mixing peat with clay or marl, and allowing the mixture to remain exposed to the atmosphere for a considerable time, frequently turning it. But nothing accelerates this process like the addition of putrescent animal matter, which acts as a ferment and greatly hastens the decomposition.

The soils for which peat forms the best manure are the chalky and clayey. Sand has too little tenacity; it lets the gases produced by the decomposition escape, instead of attracting them, as clay and chalk do, and preventing their escape.

The burning of peat destroys the vegetable matter and leaves the earths and salts behind. They are accordingly very strong stimulents to vegetation, especially that of clovers and herbaceous plants of which the leaves and stems are the most valuable parts. If the soil is well furnished with vegetable matter, and capable of bringing an abundance of seed to perfection, it may be very useful to apply stimulating manures, such as peat ashes, to increase the verdure; but on poor soils destitute of humus, the increase of the stems and leaves does not ensure a proportionate increase of seed. Hence it is often remarked that soot, potash, saltpetre, and similar substances produce a deceitful growth, giving a rank green leaf, which is not succeeded by a heavy ear; but, on the contrary, the produce in seed is rather diminished than increased by the use of the manure. Whenever a stimulating manure is used, the soil should be naturally rich, or enriching manure should be applied at the same time. It is of no use to whip a horse which has had no corn and is half starved; and land which is exhausted cannot be made productive by applying lime or ashes or saline substances, which in a richer soil abounding in humus would have excited the most vigorous vegetation.

The following particulars of the conversion of peat into a rich compost were given by Lord Meadowbank about forty years ago, and show that the principles which we have here laid down were known to him.

He recommends taking the peat out of the moss some time before it is used, that it may lose a portion of its moisture, and be lighter to carry. It is then to be carted to a dry spot, where the compost heap is to be formed. A bottom of peat is to be laid six inches deep and fifteen feet wide; on this are to be put ten inches of good yard dung, then six inches more peat, and over this four inches of dung, and so alternately to the height of four or five feet. The whole should then be enclosed all round with a wall of peat, and covered with the same material. The proportion of fresh dung is about seven cart-loads to twenty-one of peat, if the weather is mild; but more dung is required if the weather is cold: over this heap ashes or lime may now be spread, in the proportion of a cart-load to twenty-eight of the compost. The dung should not have fermented much before it is used, and if it is watered with urine or the drainings of a dunghill, the effect will be more rapid. Animal matter, such as fish, refuse of slaughter-houses, and every substance which will readily undergo the putrefactive fermentation, will accelerate the process, and save dung in the compost. Where pigeons' dung can be procured, a much smaller quantity will produce the desired effect. The heap should not be pressed down, but left to settle by its own weight. If the heat produced by the fermentation is very great, the whole heap may be turned over and more peat added to it. This will keep up the heat till the whole is reduced to a uniform mass of black mould. It may then be put on the land in the same quantity that farmyard dung would have been, and consequently, by a little labour, four times the quantity of manure is produced by the mixture of the peat with the dung. It is found that lime is not essential to the formation of this compost. The fermentation excited is sufficient to decompose the tannin and convert it into a soluble extract. The fibres, partially decomposed, are reduced into vegetable mould, and the whole assumes a uniform and rich appearance. A complete chemical change has taken place, and the peat, from being very inflammable, is now scarcely capable of combustion, and that only in a very great heat. There is no better or more economical mode of converting peat into a rich manure. In summer the whole process may be completed in eight or ten weeks; in winter it takes a longer time; and it may be useful to give the heap an occasional lining of fresh dung, as is done with hotbeds in gardens to renew the heat.

Where a great extent of peat-moss renders the improvement of it desirable, there are various ways in which it may be reclaimed. In some places the peat has been removed, and the loam which lay below it was found of a very fertile nature. This could only be done on the banks of rivers, into which the peat was floated by means of small canals dug through it, and communicating with the river. In all other cases the mode adopted has been that of draining and consolidating. In draining a peat-moss the water must not be let off too rapidly, for in that case the surface may become so loose and dry, that no vegetation can take place in it. If the water is drained off so as to leave two feet of peat dry above its level, this is all that is required for a beginning. The best improvement, and the most rapid, is produced by bringing sand or gravel in sufficient quantity to cover the surface with two or three inches of it. This will make a beginning of a soil, in which potatoes may be planted. At first the surface will not bear the wheels of a cart nor the tread of a horse; but in a short time a solid crust will be formed, which will increase in strength and thickness as cultivation advances. There are many fine pastures in Scotland which once were brown peat-mosses, on which it would have been dangerous for a man to walk, but which now bear heavy oxen, and seem as solid as any pasture on a clay subsoil. Manuring and liming are the most effective operations in bringing about this great improvement. Potatoes and oats are usually the first crops on reclaimed peat-mosses. It is long before they become capable of bearing wheat; nor is this crop to be recommended at any time, unless there be a good depth of soil formed over the peat. Laying down to grass as soon as a certain degree of improvement has been made, and depasturing with sheep at first and cattle afterwards, tend more than any other means to consolidate the surface and deepen the mould, which gradually increases by the decomposition of the tannin in the peat.

A patent has been lately obtained by Mr. Williams, managing director of the Dublin Steam Navigation Company, for compressing peat into a dense mass, so as to resemble coal. It is said to be superior to coal in its properties of producing heat by combustion, forming an excellent charcoal or coke. It is asserted that this charcoal is much more combustible than that of wood, and very useful in the manufacture of fire-works. Mr. Williams has found that with 10 cwts. of pit coal and 2½ cwts. of his factitious coal, the same quantity of steam can be generated as with 17½ cwts. of pit coal alone.

The process is as follows:—Immediately after being dug it is triturated under revolving edge-wheels faced with iron plates perforated all over the surface, and is forced by the pressure through these apertures, till it becomes a species of pap, which is freed from the greater part of its moisture by a hydraulic press. It is then dried, and converted into coke in the same manner as is done with pit coal. The factitious coal of Mr. Williams is made by incorporating pitch or rosin melted in a cauldron with as much of the peat charcoal ground to powder as will form a tough doughy mass, which is then moulded into bricks. (Dr. Ure's *Dictionary of Arts and Manufactures.*)

The use of peat for fuel is too well known to require notice; but it may be interesting to know how peat is made in Holland, where it cannot be dug out of the solid moss, but is brought up in the form of mud from a considerable depth under water. It is raised by means of small strong nets, fixed by an iron ring to a long pole, in the manner in which canals are cleared of mud. This liquid peat is brought in boats to a place prepared for its manufacture, which has been levelled as a brick-yard usually is. The soft mud is spread over this to the depth of six inches, and the water is allowed to drain off slowly: when the peat begins to dry, men fix boards to their feet and walk over it, so as to compress it; and as soon as it will bear cutting, it is cut with a spade made on purpose into oblong pieces of the usual size of peat, which is about eight or nine inches long and five wide; the treading and drying have reduced the thickness to about four or five inches. When completely solid, these peats are set on edge, and afterwards stacked loosely, so that the air may pass through them. In some places they have sheds, for the purpose of protecting them from rain. They soon become very hard, and burn more like wood or coal than the peat which is cut immediately from a solid moss. They give a very great heat, and form a coal which, when it is shut up in a close vessel to stop the combustion, and allowed to cool, has a considerable resemblance to charcoal. The ashes of this peat contain very little earth, and are very light and white. They are abundantly used as a top-dressing for grass and clover on light lands, and for this purpose are extensively exported to the sandy districts in Guelderland and Flanders. They are not so much prized for stiff soils. Dutch peat is used as fuel for all the purposes of manufactures, except for the forging of iron, for which coals are imported from England and the Netherlands. The peat-fens in Holland begin to be exhausted, and the fuel is so dear, that it is found more economical to import coals from England, which are used chiefly in cast-iron stoves.

PLANTING and PLANTATIONS.

Planting is the operation of placing in the soil the roots of a plant which has been previously removed; and the preservation of the roots is the first thing to be attended to. It should be kept in mind that the *spongioles*, or delicate extremities of the fibres, are the parts by which the chief supply of food from the earth is absorbed by the plant. Their tissue being tender and almost naked, they are very susceptible of injuries from mechanical action; and being adapted for performing their functions in a humid medium, they readily suffer from being kept for any length of time exposed to free air and drought. In taking up the plants therefore, the roots should be loosened in such a manner as to receive the least possible violence in the operation. Plants in pots can be shifted from one place to another without exhibiting symptoms of deranged functions; and if it were possible to preserve the spongioles of a large tree as entire as those of a plant in a pot, the same successful result would follow. But as it is next to impossible to do this, we can only attempt to preserve them as far as circumstances will permit. If the tree be large, a trench should be opened beyond the extremities of the roots, of sufficient width and depth to allow the process of undermining to be freely carried on. The roots should be gradually set at liberty by a round-pronged fork, the prongs tapering so as to be easily inserted, yet not by any means so sharp as to prick the roots. As the fork is being used, the soil from among the roots will fall into the open trench, but as it accumulates there it must be cleared away, and at the same time the portion of roots set at liberty will require to be slightly tied together with pieces of matting, and, if necessary, supported by temporary stakes, or held to one side by an assistant, whilst the planter proceeds in liberating others. If there be, as is frequently the case, a tap-root extending to a much greater depth than the other roots, and if the latter have been carefully preserved during the operation, the tap-root may be dispensed with, for it could only be raised in a mutilated state, owing to the great solidity of the earth at such a depth.

Although it is very desirable to preserve the greatest possible quantity of sound roots, yet all that are bruised or lacerated should be cleanly amputated up to the sound parts. Cross-roots are apt to gall the others when they become large, and therefore the sooner they are removed the better. When the plants are young and in the course of being occasionally removed in a nursing state, all irregularities in the roots should be corrected, which can then be done with comparatively little injury, as the roots of young plants bear a greater proportion to the top than seems to be the case at a more advanced period of growth, and the loss of any of them is consequently felt less. In the early stage of rearing trees, while the proportion of roots predominates, it may be found advisable in various cases to shorten not only the tap-root, as above mentioned, but also judiciously some of the other strong roots, in order that subdivisions of a more fibrous nature may be produced, and a number of rootlets substituted for large root-branches. Even in the case of large trees this principle has been acted upon for centuries, and latterly it has been strongly advocated and put in practice for the purpose of producing immediate effect in park or landscape scenery. A trench is cut out round the tree, and the roots shortened wherever they happen to traverse this trench, so as to leave it quite clear. This being done, the trench is filled up, either with its own excavated soil, or, in very particular cases, with fresh soil. The tree has still a sufficient number of undisturbed roots to keep it alive; and in fact it ought not to be merely kept alive, but as many roots should be left as will ensure its continuing in a healthy though not a vigorous state of growth. In the course of a year or two after this operation has been performed, a number of young roots will have been protruded from the various amputations into the loosened soil of the trench; and partly from the possibility of preserving these roots, and partly from the top becoming habituated to a more limited supply of food, the tree feels comparatively little the change consequent on transplantation.

Roots may be produced of a proper description for planting by the adoption of such means as the above, and if care be taken, they will suffer little from the operation of removal. Still they may be seriously injured from exposure to air, and more especially to drying winds, frost, and even to wet. To be covered in the soil is the natural condition of the roots of most vegetable productions, and therefore endeavours should be made to place them in such a condition with the least possible delay; or at all events, if circumstances render delay unavoidable, such means should be adopted as will preserve them in a state of moisture similar to that which they have in the soil. It is however necessary to observe, that when the tops are closely packed up and evaporation from them prevented, the roots should be kept rather dry than otherwise, for under such circumstances damp is found to be much more frequently destructive than a little dryness.

Though the preparatory steps to planting, as regards roots and their preservation, may be properly taken, yet, if the operation be not performed at the proper season, success will not be complete. It is true that instances may be adduced of planting being done at the very opposite season to that which is here recommended as the best; but such cases are only examples of what may be done by extraordinary care in adopting artificial means so as to imitate more natural circumstances. It is a well known fact that plants are subject to a process of evaporation from all the parts which are exposed to the atmosphere, provided the latter is not in a state of saturation. The source from whence this evaporation is supplied is the moisture of the soil, and the roots are the media by which it is collected and transmitted to the stem, branches, and leaves. If the expenditure be greater than the supply of moisture, the plant will begin to suffer; if the disparity be great and continued, a degree of desiccation will be occasioned sufficient to deprive the vegetable tissue of that moisture which constitutes the medium of intercommunication between the different cells; organization is destroyed; the chain which connected it with vitality is broken, and incapable of being reunited by any mechanical means.

A much greater amount of evaporation takes place from a given surface in some species than in others; but the amount as regards plants of the same species, all other circumstances being the same, is in proportion to the extent of surface which the respective individuals possess. The leaves of a lime-tree may have a surface equal to thirty times that of the stem, branches, and twigs which produce them, and consequently the demand on the roots for the supply of evaporation will be thirty times greater when in leaf than when the branches are naked. Instances might be adduced in which this difference would even be exceeded; but if, on the contrary, it were found considerably less, still there would be sufficient evidence of the impropriety of moving plants when in leaf: and it may be here remarked, that young leaves admit of the fluids being more rapidly evaporated than old ones.

The month of December is that in which the condition of the air with regard to moisture approaches nearest to that of complete saturation, and next in this respect is January, which is also the coldest. It might therefore be concluded that these months are the best for planting, more especially as they are the most opposite in character to June and July, which, from their being the hottest and driest, are found to be the worst. But November is also moist; and although the temperature of the season has not then reached its minimum, yet the foliage, accustomed to exercise its functions under a summer heat, can no longer perform them under a reduction of temperature, which, though not the lowest, is comparatively low as regards summer productions. The leaves in consequence lose their connection with the roots; the earth still retains considerable warmth; and although the absence of leaves in deciduous trees, and perhaps the inactivity of those of evergreens, may prevent the formation of wood, except in the most limited degree, yet the buds, whilst they are themselves increased in volume, maintain a corresponding action in the roots, sufficient in many instances to form fresh spongioles before winter, a process which is favoured by the soil being warmer than the atmosphere. Should circumstances occur to prevent the actual protrusion of cellular substance in the form of spongioles, still an accumulation of it will be taking place, ready to burst forth in spring. On this account therefore, although December, January, and February are sufficiently moist, yet November, or as soon as the leaves have fallen, is the preferable season for planting. There may be some exceptions, as in the case of very wet soils, where the plants, if not firmly rooted, are liable to be thrown out during winter, owing to which spring planting would be more proper. But under ordinary circumstances all deciduous trees will succeed best at the period above indicated. Such species as push forth their buds early ought certainly to be planted in autumn. Many of the Coniferous tribe will succeed well if planted soon after they have made their summer's growth: the earth is then warm, and the plants make roots very promptly. Some species of this interesting order of trees require to be planted either before winter, so as to have sufficient time to strike root, or immediately before their buds begin to burst in the spring. These species of trees are injuriously affected by exposure to dry cold winds, even when their roots are undisturbed by removal; but if planted at a season when several months must elapse before any perfect action can commence, the tops are apt to become dried up in the interval. It appears that if their juices become inspissated to a certain extent, they never again become liquified, probably owing to their resinous nature.

The watering of newly planted trees ought to be attended to. The supply in the first instance should be copious, in order to wash the earth into the cavities among the roots. Some err in keeping the roots of newly planted trees constantly soaked with water, as if they were those of bog-plants, for which only such treatment is proper. In watering, consideration should always be had to the nature of the plant, to which, if it delight in dry soils, no more water should be artificially applied than is necessary to moisten it as much as the soil in which the species grows naturally, and at a time when shoots and leaves are abundantly produced. When watering is performed, it should be done thoroughly, so as to reach the lowest portions of the root. In the case of plants being much dried from long carriage or other causes, the supply on first planting should be very moderate. The tops however should be frequently syringed, in order to moisten the bark and prevent its absorbing the organisable matter which descends towards the root by the inner bark. The flow must be extremely weak under such circumstances; but if it can be preserved from the effects of drought till it reach the extremities of the roots, the formation of fresh spongioles will immediately commence, and the tree may then be pronounced out of danger.

The manner of performing the operation of planting may be reduced to one general principle, that of placing the roots in the soil so as to imitate as closely as possible the position which they occupy when growing wild and uncontrolled. Plants indeed may be instanced whose roots have been observed in one situation penetrating to the depth of four or five feet; or in another, creeping along the surface, amongst stones, or into the crevices of rocks, with scarcely soil to cover them, as for example in the vine. But although roots can usually accommodate themselves to that position which the nature of the situation renders it alone possible for them to occupy, yet there can be no doubt that in all cases the extremities of the roots should be lower than where they diverge from the stem, a rule which, however self-evident it may be, is frequently violated in practice by making a basin-shaped hole, deepest in the middle, in which the roots are either doubled or have their extremities tending upwards on the sloping sides of the cavity.

The excavation for the reception of the roots of a plant should be considerably larger than those roots will traverse when extended at the time of planting. It should be as wide at bottom as at top. The bottom should be more or less convex, and the depth such as to admit of the roots being covered to the extent observed in undisturbed seedling plants of the same species; that is to say, the upper part of the root should only be just covered. The lower roots should be regularly disposed over the convex bottom of the excavation, and carefully strewed with some of the finer portion of soil, over which the other roots may be spread. More soil should then be carefully rather than forcibly introduced. There should be no vacant spaces left, except those of so minute a description that they will be readily filled up by the finer particles of earth washed down by a plentiful watering. This watering should be given when the soil is nearly all filled in; and after the water has subsided so as not to stand above the surface, the latter should be covered with the remaining portion of soil. Except in very loose or light soils, this method will supersede the necessity of the hard beating and treading in to which the roots of trees are very generally subjected. The latter practice is now however being laid aside by many, from a conviction of its injurious effects. It is also necessary to remark that a plant should be placed, before the introduction of the soil, exactly as it is intended it should stand; and it should not be pulled from side to side for the purpose of shaking the earth amongst the roots. If the tree be drawn to one side, the fibres of the root will also be drawn towards the same side; but they are of course too flexible to force their way back when the tree is drawn in a contrary direction, and they must therefore become more or less doubled. Nor should the soil be thrown *against* the fibres whilst the roots are being covered; it should be made fine, and either shaken from the spade so as to fall perpendicularly among the roots, or scattered by a force impelling it in the direction of the fibres, which will be in general from the stem towards the extremities, or from the centre to the circumference.

The principles here stated are applicable to the planting of large as well as small trees, and in fact to any terrestrial species of plant. There are however many modifications in practice, some of which may be noticed as proper under certain circumstances, and others as only to be condemned under any circumstances whatever.

Small plants are very frequently inserted by the *dibber*, a cylindrical piece of wood, shod with iron and tapering to a point. This is thrust into the soil, and in the hole formed by this means the roots of the plant are introduced, and a portion of soil pressed towards them by a second stroke of the dibber. It is evident however that by this procedure the roots cannot be in the most natural position; they are in fact the very reverse of being spread out to the best advantage. In the case of very valuable species, the spade or planting-trowel is used in preference to the dibber. The latter has nothing to recommend it on the score of good principles in planting; the expedition with which it can be employed is all that can be said in its favour.

Besides the spade and dibber, various other implements are used in planting, such as the *diamond dibber*, a pointed plate of steel with a short iron handle; a *mattock*, used in stony soils; and some others, adopted according to circumstances. In all cases however where the spade can be used, it is undoubtedly the best instrument. If the soil be unfit for allowing the use of the spade, it should be rendered fit previously; and if some time be lost and expense incurred by using it instead of smaller and more expeditious, but at the same time more cramping implements as regards the roots, the difference will certainly be ultimately in favour of a proper disposition of the roots by means of the spade.

With regard to the preparation of the soil for plantations, it is found that trenching the ground is attended with profit where it is practised for the purpose of rearing wood for fuel and small timber. This mode of preparation ought likewise to be adopted where trees are intended to be planted for ornament or for shelter. It has not been generally attempted in the case of extensive plantations of heath or rugged mountain-land. It may however be affirmed without hesitation that great advantages would be derived from the operation being more extensively performed. Something more than merely burying the roots of hard-wooded plants is thought necessary, and accordingly *pits* are made. It is scarcely necessary to observe that if these are not of considerable size, the direct progress of the roots is soon obstructed. The time required to form these pits as they ought to be, would be sufficient to regularly trench double their area. The expense of trenching the intermediate spaces will be compensated by the greater return derived from the nurse plants, such as larch, when they come to be removed.

Plantations are generally planted thick in the first instance, and with various species of trees. Larch, Scotch fir or pine, mountain ash, &c. are interspersed amongst the hard wood for shelter, or as nurses. Laburnum is also useful for preserving the other sorts from the depredations of hares, as they prefer the laburnum to every other bark. Nurses are generally left till they are fit for various purposes for which small timber is applicable. They should be planted closer to each other than to the principal trees intended to constitute the more permanent part of the plantation.

After all the care of the planter and the skill with which the operation of removal may have been effected, much of the success of a plantation depends on the proper adaptation of species to the soils and situations most suitable to them.

The following remarks upon some of the timber-trees principally cultivated may be useful.

The oak, *Quercus robur*, and *Q. sessiliflora*, prefers strong or even clayey loam; any soil not wet or chalky.

Beech, *Fagus sylvatica*, calcareous soils, gravelly or sandy loam; dislikes stiff clay.

Elm, *Ulmus campestris, U. glabra, U. montana*, attains, near the banks of rivers, a large size; thrives in most soils.

Ash, *Fraxinus excelsior*, prefers a dry subsoil; dislikes stiff clay.

Plane, *Platanus orientalis*, rich warm soil, tolerably moist, but not retentive.

Sycamore, *Acer pseudo-Platanus, A. platanoides*, best in moist deep soil, but will thrive in others not too stiff; withstands the sea-breeze.

Chestnut, *Castanea vesca*, deep sandy loam.

Walnut, *Juglans regia*, deep loam with a pervious subsoil; dislikes strong clays.

Hickory, *Carya alba*, similar soil to that required by the walnut.

Acacia, or locust-tree, *Robinia pseud-Acacia*, sandy loam; a sheltered situation; cannot bear storms.

Birch, *Betula alba*, forms best timber on dry sandy or gravelly soil.

Laburnum, *Cytisus alpinus*, any soil not too wet.

White Bean, *Pyrus Aria*, any good soil, with a pervious subsoil; dislikes wet clay.

Lime, *Tilia Europæa*, soft deep loam, in low rather moist situations.

Horse-Chestnut, *Æsculus Hippocastanum*, deep loam; not in exposed situations.

Poplar, *Populus alba, P. canescens, P. nigra, P. tremula, P. fastigiata, P. Græca, P. monilifera*. These thrive in almost any soil, but best in that which is deep and rather moist.

Mountain-Ash, *Pyrus Aucuparia*, any soil, wet clay excepted; adapted for high situations.

Alder, *Alnus glutinosa*, moist or even swampy soil.

Willow, *Salix*, of numerous species. Some thrive in rather dry soil, but all prefer moist.

Pine, *Pinus sylvestris, P. Laricio, P. Pinaster, P. Strobus*. The two first are adapted for thin, rocky, gravelly soils; they grow at a great elevation on the warmest sides of mountains, but better in mountain glens; they dislike stiff clay and deep strong loam, and, like all coniferous plants, they do not thrive on chalk. *P. Pinaster* and *P. Strobus* require a less exposed situation than the other two.

Spruce, *Abies excelsa, A. alba, A. rubra, A. nigra*, deep moist soil, in low situations; dislikes thin sandy soil and exposure.

Larch, *Abies Larix*, adapted for thin mountain land, or any soil of which the subsoil is not retentive, excepting however red-sandstone or chalk, as above mentioned.

Cedar of Lebanon, *Abies Cedrus*, any tolerably good soil, rather deeper than for the larch, but a pervious subsoil, free from stagnant water.

Too close planting produces weak drawn-up timber, in consequence of the tops only receiving a due share of light. It is true that the most magnificent trees are found in those ancient forests that have never been sown, planted, or thinned by the hand of man. But at the same time it will not be denied, that wherever natural forests exist, the soil and situation must be exceedingly favourable for the species produced; and that although thousands sprung up more than could possibly find room to attain perfection, yet those only that were the most favourably circumstanced and most vigorous would continue; and when once their tops got completely above those of the general mass, the latter must have inevitably fallen into decay. There is no reason however to suppose that those which maintained their ground, and, favoured by propitious soil, became lofty specimens, would not have been benefited by the assistance of the axe to relieve them sooner from their rivals.

If, on the contrary, trees are planted at too great a distance from each other, they are inclined to ramify into large limbs and spreading tops, with a stem short but much thicker than where the space admits of less expansion of foliage. If therefore very thick timber of no great length be required, wide planting is proper; but if tall timber be the object, the plantation must be moderately thick.

The care which plantations require from year to year consists in making up deficiencies, thinning, and pruning. Deficiencies seldom occur if the planting be at first duly performed; and every endeavour should be used to prevent the necessity of *making up*. This is always done with considerable disadvantage to the plants thus introduced, unless the spaces be trenched; but in that case, if the species of tree be properly chosen, the plants may do well in consequence of the shelter afforded by the older surrounding individuals.

Thinning should be commenced in due time. No branch of the temporary trees should by any means overhang the top or even branches of those that are permanent. The shelter on the most exposed sides of the plantation should be formed of robust, vigorous, growing kinds, and it should be allowed to remain unbroken. Plantations that have been neglected till they have formed a dense thicket must be thinned gradually; for if thinned at once, those left would be injured by the sudden exposure, and would be blown over by winds.

Pruning is an important operation in the management of plantations, but it is often improperly practised for want of the knowledge of a few physiological facts, which are essentially necessary to be stated before any rules for pruning can be properly given. If these facts be understood, few rules will be required, but otherwise a volume of directions are liable to be misapplied. It ought therefore to be understood, that the sap ascends from the stem chiefly through the alburnum, or outer layers of young wood. It then enters the leaves, when it is exposed to the influence of light. Having in consequence undergone an elaboration, it descends on the outside of the alburnum, that is to say through the inner bark, the internal surface of the latter possessing a great degree of lubricity, whereby the passage of a portion of the juices at least is facilitated to the roots, whilst part is detained and becomes organized by the action of the medullary rays, forming a new layer of woody matter. The thickness of the layer so formed is very different in different species; but in the same species, all other circumstances being the same, it is in proportion to the surface of leaves. The aggregate horizontal growth, or in other words the diametrical extension of the stem, branch, and even roots, depends upon the quantity of healthy foliage. The diametrical increase of any particular part corresponds with the greater or less proportion of foliage above that part. Again, it may be stated that if one tree has a clear stem of 20 feet in length, and another has one of 40 feet, the roots and foliage of both being equal, the layer of new wood will be much thinner in the latter case than in the former; for the deposition of woody matter will have to extend over double the surface in the tall tree. It may be also remarked, that, in general, if a tree be left entirely to nature, it will ultimately produce a greater bulk of wood, taking stems and branches together, than would be the case if subjected to pruning. Except however in the case of growing for fuel, pruning is more or less necessary. The value of a timber-tree depends chiefly on the stem, the branch timber being of less value. The object to be kept in view in pruning for timber is the production of a clean stem with as small a proportion of branches as possible. But it has been explained that the growth of the stem depends on the quantity of foliage, and without branches a sufficient quantity of foliage cannot be maintained. Whilst, on the one hand, an undue preponderance of branches is prevented by pruning, yet, on the other, as much foliage should be preserved as circumstances will permit.

An excessive privation of foliage should never be occasioned at any one time. It is therefore advisable that pruning should be commenced early, in order, as it were, to repress irregularities in the bud. At all events, whenever an irregularity can be clearly distinguished as such, it should be checked. Thus, when a shoot, occupying the position of a branch, ascends in competition with the top, or leading shoot, and is allowed to go on for years, the stem will have a forked character; or if the competing portion be amputated after it has acquired a large size, the timber will be rendered unsound. But if the shoot from which this aspiring limb took its rise had been stopped in the first or second season of its growth in summer, the tree might have been grown with a clean regularly tapering stem. It is only great irregularities however that should be meddled with during the early growth of the plant; otherwise the increase of roots is prevented, such increase being reciprocal with that of the branches.

Young shoots of the above description may be checked by being shortened in summer; but no large branches should be cut off at that season, nor after the sap begins to flow briskly in spring. Towards autumn however, when the leaves have nearly ceased to carry on their functions, pruning may be very properly performed; and some species, for example the birch and maple, require to be pruned at that time, otherwise they are apt to bleed. The period at which *bleeding*, that is, an extravasation of sap, takes place with greatest force, is immediately before the bursting of the buds in spring. If a branch be cut off when in foliage, the remaining portion draws the sap and prevents effusion at the wound. Some derangement will of course be produced in the flow of sap; and a diminution of the process of lignification and of the formation of roots will be occasioned, owing to the abstraction of a certain extent of foliage. But when the sap is in motion, and the leaves at the same time not expanded, the amputation of a branch is followed by a flow of sap, which appears to drain from every part of the tree. The sap becomes stale on exposure to the air; it then affects the cambium and inner bark, often to a considerable extent below the wound, and if these are not in all cases so far completely killed, yet they are generally more or less injured, and canker is apt to ensue.

Supposing it were required to rear a tree so as to have a stem of clean-grown timber, as tall and as thick as could possibly be obtained in any given time. The first consideration is the root, the plant being supposed to be young, with a top or upright leading shoot, and several side branches. All these should be left undisturbed in the first instance, unless such of the latter as may require a check if growing too strong for the others or for the leader. The laterals should be left, for the sake of the roots, till their presence on the stem becomes inconsistent with the object of producing it as free as possible from knots, taking also into consideration that the difficulty in healing the wound increases as the branches get older. A *few* of the largest shoots should be those first removed. They may be shortened in the first instance after midsummer, and afterwards cut off smoothly by the lowest circular wrinkles which form round their base, close to the stem, but without slicing off a portion of the bark; a slovenly practice, of which only bad pruners are guilty, and which can only have the effect of diminishing the power of the bark to close over the wound necessarily made by the pruning-knife. Such unnecessary wounds cause an extravasation of sap, as may be seen especially in coniferous trees, where they are generally covered with resinous exudations. In the following season the next largest branches should be in like manner displaced, care being still taken, on account of the importance of the foliage, as already explained, that the quantity removed shall be no more than is absolutely necessary.

Small branches along the stem should be left till they approach the dimensions by which the removal of the others is regulated. These principles should be followed up till the required height of stem is attained; after which the branches composing the top shall be allowed full freedom, in order to increase, by their organising power, the diameter of the stem.

Coniferous trees require little pruning; nor is it necessary to commence so early with them as in the case of other kinds. In dense forests they are found with straight stems approaching the height of 100 feet clear of side branches, the latter gradually decaying below as they become excluded from light and moisture by those above them. When from this cause the lower branches of coniferous trees are observed to lose in a great measure their vigour, and when their foliage contributes little to the enlargement of the stem, they may then be very properly cut off, without waiting for their actual decay. It is a question whether the branches of these trees should be cut close to the stem at once, in pruning; or whether they should first be *snagged*, that is, cut at some distance from the stem, and either allowed so to remain or be afterwards cut close. That plan is best to adopt by which the least exudation of resinous substance is occasioned, and the blemish soonest overgrown. With the view of preventing the former, the branch may be shortened only to the first live twigs, so as almost to nullify its connection with the stem, preparatory to its final and close removal in the following season.

By choosing the proper season, and by previous shortening, large limbs of any healthy tree may be closely amputated so as to heal over without affecting the tree generally, or even the portion of stem more immediately connected with the limb to any material extent; yet the new layer of wood will prove, on cutting up the timber, to be only in close contact with the surface of the wound, which will remain dead, and with which the living matter enclosing it could not coalesce. A piece of unsound wood is thus embodied. In this case it would be advisable to shorten the limb to such of its laterals as will just be sufficient to keep it alive till the tree is felled. If, in the interval, the branch should push vigorously, means must be adopted to keep it always in a reduced state, by merely allowing as much foliage as will keep the branch alive, without affording any material addition to its diameter.

The proper season for felling trees is when the sap is most at rest. The operation ought not to be performed at any other time, unless for fire-wood. The quantity of sap that may be drawn from some trees is very great. This sap contains the elements of fermentation, the powerful effects of which are evident even on the strong fibre of the oak. Softer woods, although very tough if cut at the proper season, have been observed to crumble almost to powder in a year or two, in consequence of having been cut when in sap.

With reference to this subject, Miller in his 'Gardener's Dictionary' (1768), has the following remark: "Before I quit this subject, I must beg leave to take notice of another great evil, which is of so much consequence to the public as to deserve their utmost attention; which is, that of cutting down the oaks in the spring of the year, at the time the sap is flowing. This is done for the sake of the bark, which will then easily peel off; and for the sake of this, I think there is a law, whereby people are obliged to cut down their timber at this season. But by so doing the timber is not half so durable as that which is fallen in the winter, so that those ships which have been built of this spring-cut timber have decayed more in seven or eight years than others which were built with timber cut in winter have done in twenty or thirty; and this our neighbours the French have experienced, and therefore have wisely ordered that the bark should be taken off the trees standing, at the proper time, but the trees left till the next and sometimes until the second winter before they are cut down; and the timber of these is found to be more durable and better for use than that of any trees that have not been peeled. Therefore I wish we were wise enough to copy after them in those things that are for public good."

It may be observed, that at the time Miller wrote, the celebrated physiologist Duhamel was inspector-general of marine in France, and had been most probably the means of pointing out the evil, and proposing the remedy above referred to. This plan of barking in the spring and felling in the succeeding autumn is however by no means unobjectionable, and on some accounts is decidedly inferior to felling in autumn or very early in winter without previous disbarking.

(Sang's *Planter's Kalendar;* Loudon's *Arboretum Britannicum; Encyclopædia of Gardening.*)

PLOUGH. That the plough is an instrument of the highest antiquity is apparent both from the oldest writings that we possess and from the existing monuments of Egypt. We might exercise our imagination in supposing a probable origin of the plough in the branch of a tree dragged along the ground, in which the stump of a smaller branch made furrows as it went on. It seems indeed probable that some accidental circumstance first suggested this mode of stirring the earth to prepare it for receiving the seed.

The oldest forms of the plough of which we have any description in ancient authors, or which are represented on monuments or coins, are very simple: a mere wedge, with a crooked handle to guide it, and a short beam by which it was drawn, form the whole instrument. The light Hindu plough, now in use in many parts of India, seems to differ little from the old model.

Before we enter into any details, it may be as well that we describe the different essential parts of a plough, by the names which are usually given to them.

The body of a plough is that part to which all the other parts are attached. The bottom of it is called the *sole* or *slade*, to the fore part of which is affixed the *point*, or *share;* the hind part of the sole is called the *heel*. The *beam*, which advances forward from the body, serves to keep the plough in its proper direction, and to the end of it are attached the oxen or horses which are employed to draw it. Fixed in the beam, in a vertical position, before the point of the share, with its point a little forward, is the *coulter*, which serves to cut a vertical section in the ground, while the point of the share, expanding into a *fin*, separates a slice by a horizontal cut from the subsoil or solid ground under it. The *mould-board*, or *turn-furrow*, is placed obliquely behind the fin, to the right or left, in order to push aside and turn over the slice of earth which the coulter and share have cut off: it thus leaves a regular furrow wherever the plough has passed, which furrow is intended to be filled up by the slice cut off from the land by the side of it, when the plough returns. The stilts or handles, of which there may be either one or two, as is thought more convenient, direct the plough by keeping it in the line required and at a regular depth in the ground. The single stilt appears to be the most ancient form.

Wheels are a modern invention in comparison with the other parts. They support the end of the beam, and prevent it from going too deep into the ground or rising out of it while the plough is going on. The greatest improvements introduced into modern ploughs are in the shape of the mould-board, or turn-furrow, of which we shall take particular notice, and the contrivances for regulating the line of draught, so as to make the plough go at an equal depth, and cut off a regular slice of equal breadth, without any great force being applied by the ploughman who holds the stilts.

The Hindu plough consists of a slight beam, often without any coulter, a narrow share, and a corresponding stilt. The whole is of wood, slightly pointed with iron. It is so light that a man can readily carry it upon his shoulder. When it is at work it is usually drawn by a small buffalo, and sometimes by a man or a woman. This instrument is intended merely to make a shallow furrow in a very light soil, or in the mud produced by irrigation where rice is cultivated. It does not act as our ploughs do, nor does it turn over a regular furrow, but it acts more like one of the tines, or teeth, of some of our more complicated instruments called cultivators or grubbers, with which the earth is stirred without being turned over.

The Chinese plough resembles the Hindu in its simplicity. The earth is turned over by holding the instrument obliquely, and much depends on the art of the ploughman, in whose hands it is like a stout shovel pulled through the ground by a horse or ox. The sole is not straight, but rounded like the bottom of a boat. The work done by this instrument is not unlike the furrow drawn in the sand at the bottom of the sea when a ship drags her anchor.

The ploughs in use in different countries in Europe have undergone little change for many centuries; it is only lately that any attempt has been made to vary the old forms.

The Roman plough, such as is described by Virgil in the ‘Georgics’ (i. 169), is still used in many parts of France, under the name of *Araire Romain*. It consists of a beam (*temo*), a body (*buris*), a share (*vomer*), and a handle or stilt (*stiva*). The office of the turn-furrow is performed by two pieces of wood about six inches long projecting obliquely upwards, and very properly called teeth (*dentalia*), E F (*Fig.* 1). The sole of the plough AB has two pieces of wood CG and DH fixed to it on each side, forming an acute angle with it, in which the teeth are inserted. This exactly answers the description of Virgil, " Duplici aptantur dentalia dorso" (the teeth are fitted to the double back).

Fig. 1.

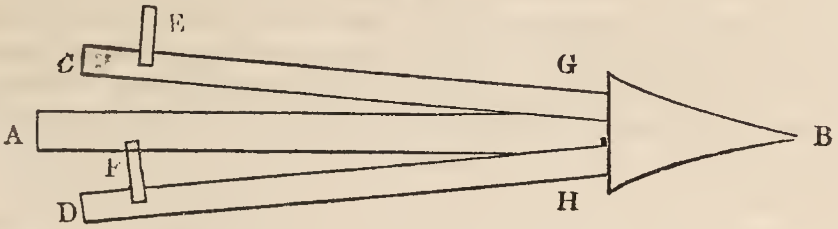
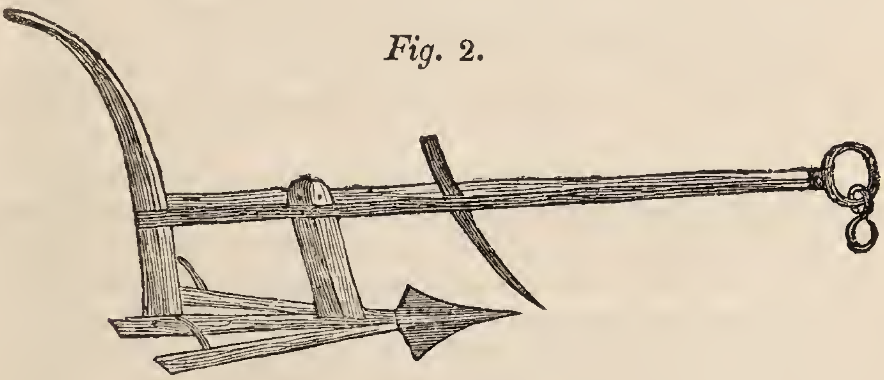


Fig. 2.



Roman Plough.

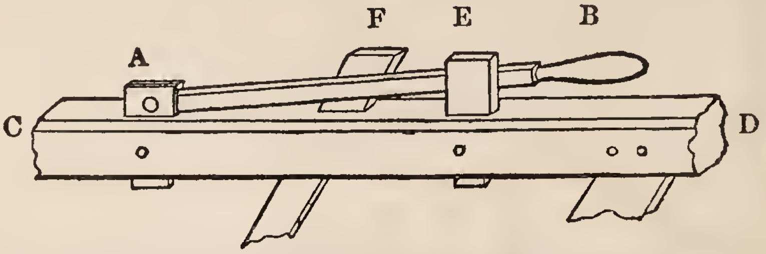
These teeth help to push aside the earth to the right and left, and the instrument resembles what is called a moulding plough, which is used in throwing the soil aside against young plants growing in rows, as turnips, potatoes, &c. A chain or pole connected with the end of the beam was hooked to the middle of the yoke on the neck of the oxen, and thus the plough went on making parallel furrows, so near to each other that the preceding furrow was partially filled with the earth which the dentalia pushed aside. The point was in the shape of the head of a lance. This plough might suffice in light mellow soils, which had been long in cultivation and had more the texture of garden mould than of stubborn clay.

The small double mould-board plough, common in other parts of France, is evidently taken from this. The teeth not being sufficiently strong, a slanting board was substituted on each side, and wheels were added, to diminish the labour of the ploughman. The stilt remained the same at the place where it is attached to the plough, but higher up it was divided into two, like a fork, for the convenience of holding it with both hands. This plough acts exactly like the other, but it is stronger and better adapted for heavier land. Neither of them goes much deeper than four or five inches, leaving shallow parallel ridges, in which the seed falls, and is buried by light wooden harrows, which are drawn over the land after sowing. This is an imperfect tillage, the bottoms of the furrows being only partially stirred. The broad flat share, and the single mould-board which turns the earth completely over, after lifting it up, is a far more effectual instrument, and has been adopted wherever agriculture has made any improvement. This plough more nearly imitates the digging with a spade; and the more perfect the imitations, the better is the work.

The mould-board of a modern plough is either fixed on one side, or made so as to be shifted from one side to the other. In the first case half the furrow-slices lie on one side and half on the other, and there is of necessity a double furrow where they join. When it is desirable that the surface should be quite flat, and the furrow-slices all in one direction, the mould-board must be shifted at every turn, and a plough which admits of this is called a turn-wrest plough.

It is evident that the mould-board of a turn-wrest plough must be so constructed as to act with either side uppermost; it can therefore have only a very slight convexity to push over the slice cut off by the coulter and share; and a considerable force is lost by the obliquity of the action in doing so. The share of this plough is pointed like a lance, or presents a flat edge like a broad chisel, according as the soil is light or heavy. The point of the coulter is placed on line with that side of the point which is nearest to the unploughed land, and this is done by means of a piece of wood AB (*Fig.* 3), which presses it against one side or the other of the mortice in which it is placed in the beam CD, by changing the position of the pieces AB to the other side of the projection E on the beam, and pressing the head of the coulter F to the other side. The mould-board has a hook at the fore part, which goes into a staple in the side of the fore-part of the body of the plough towards the preceding furrow: a piece of wood on the inside of the mould-board keeps it at the proper angle with the line of the sole.

Fig. 3.



The defect of this plough is in its weight and clumsiness more than in the shape of the mould-board; for when it is made lighter, it is not so bad a construction as appears at first sight, and it does its work very neatly in heavy loams with a dry subsoil. If, instead of one mould-board, two were used alternately, of a better shape for turning over the furrow-slice, this plough would be much improved.

The form of the turn-furrow is of material importance, for on this depends not only the perfection of the work, but also the lightness of the draught. When we follow a plough working in a mellow soil which slightly adheres to the plough, we often perceive that, instead of being turned aside, the earth is carried forward, and only falls off when the accumulation of it becomes heavy enough to overcome the adhesion. It does not slide off from the mould-board itself, but separates from the earth which adheres to the latter; thus showing that the shape is defective, and giving good hints for its improvement. But as the same plough will sometimes turn over the same earth better when it is either drier or moister, it is very difficult to determine, by experiment only, what may, on the whole, be the best shape. A little reflection and the application of scientific principles may greatly assist us here. It is not sufficient however to find the curve which will make the plough go through the ground with the least force. The plough must also perform its work perfectly, and if anything is to be sacrificed, it is better to employ more power than to plough the ground badly. After having ascertained the mechanical principles which bear on the working of the plough, we must observe its action carefully, follow the plough day after day, in different soils and different weather, and thus we may be led to observe all the circumstances which attend its operation, and correct any mistakes which an erroneous theory might have led to.

Many attempts have been made to ascertain the exact curve which the turn-furrow should have to perform the work well and at the same time to produce the least resistance. The difficulty of the problem lies in determining the data, or principles on which the investigation is

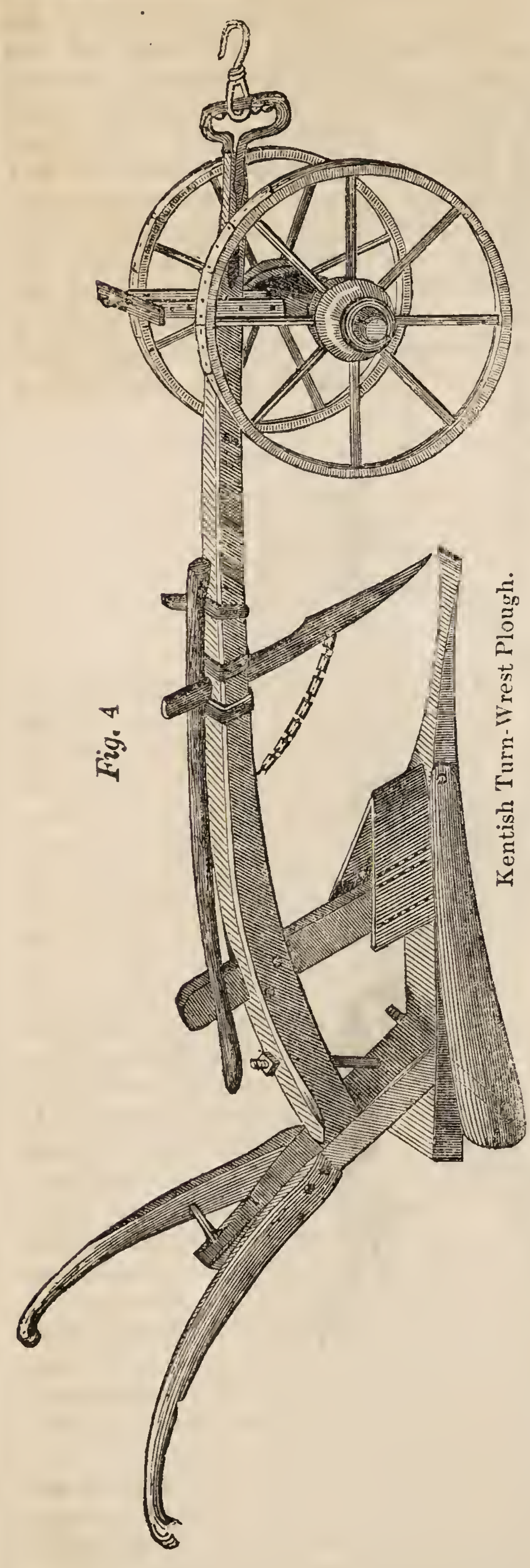


Fig. 4

Kentish Turn-Wrest Plough.

founded; and these are so various, that it is not surprising that no very satisfactory conclusion has yet been obtained. We will make an attempt at a solution from a simple examination of the motion to be produced in the portion of earth to be turned, which we call the furrow-slice. We shall suppose this separated from the adjacent soil by the vertical cut of the coulter, and at the same time from the subsoil by the horizontal cut of the share; a section of the slice, by a plane at right angles to the line of the ploughing, will be a parallelogram A B D C (*Fig.* 6), the depth A C being the thickness of the slice, and A B its width. Confining our attention to this section of the slice, the object is to move it from its position A B D C, as cut off by the coulter and share, to that of $b' d' c' a'$, where it is inclined at an angle of 45° to the horizontal line; the surface A B ($b' a'$) being laid on the slice previously turned over, so as to bury the grass or weeds which might be rooted there, exposing the roots to the sun and air. The more uniformly this motion is produced, and the more regularly the successive sections follow each other, the less power will be required to turn over the whole slice. The motion of C D round the point D must therefore be uniform. If the turn-furrow is horizontal at the point where it joins the share, and of the same width as the furrow-slice, it will slide under the slice; and if the vertical sections of its upper surface, at equal distances from the share, are inclined at angles regularly increasing with this distance till it arrives at the perpendicular, the turn-furrow will, as it advances, turn the slice from a horizontal to a perpendicular position; the section of it will then be D*cab*. The inclination of the section of the turn-furrow must now be to the other side, forming an obtuse angle with the section of the sole, until it has pushed the slice over at the required inclination of 45°, which theory and experience have shown to be the best adapted to expose the greatest sur-

Fig. 6.

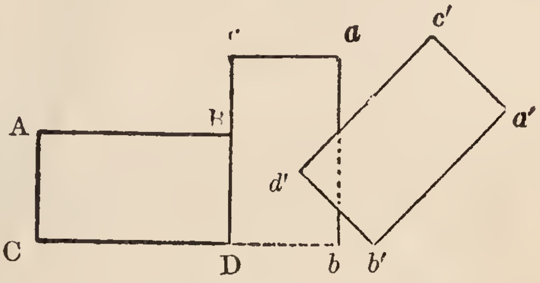
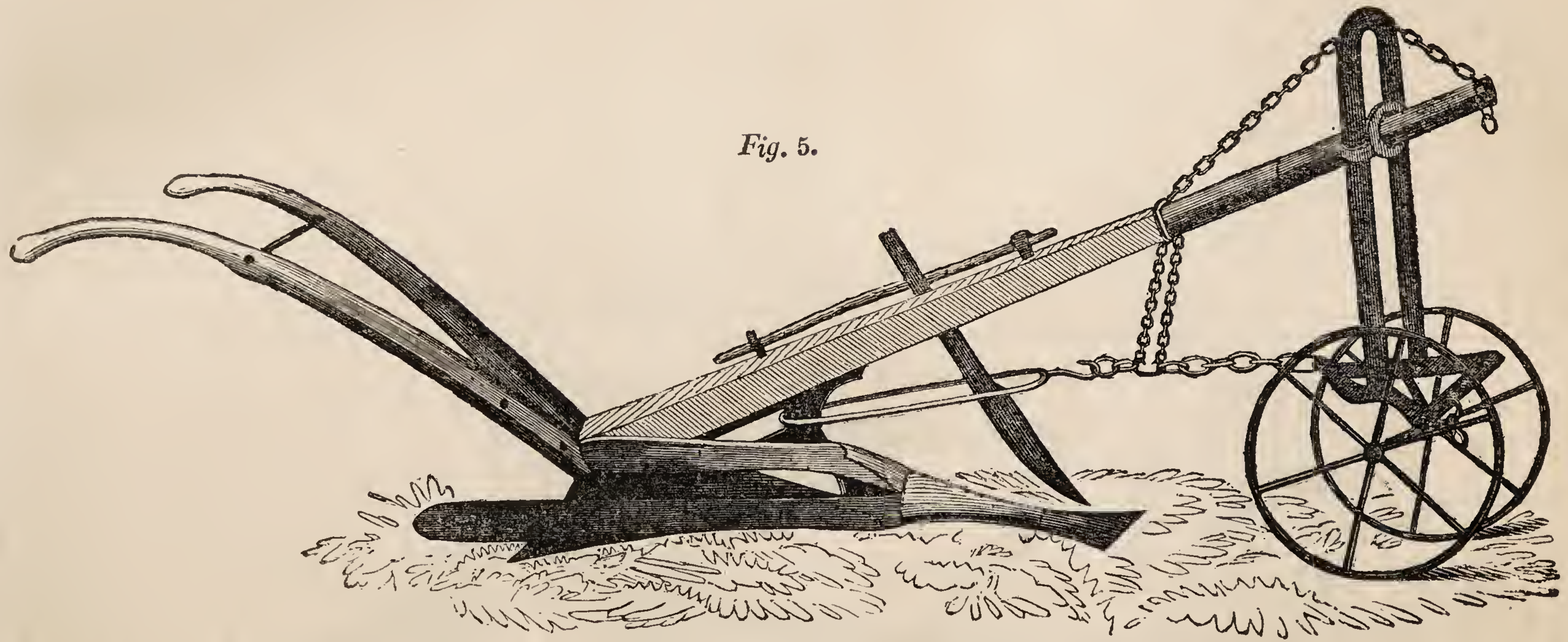


Fig. 5.



Ransom's Kentish Turn-Wrest Plough.

face to the action of the atmosphere, and likewise to form the most regular furrows for the reception of the seed, which the harrow can then most readily bury.

The surface of this turn-furrow is curved in the form of the spiral thread of a screw, such as would be generated by a line moved uniformly forward in a direction at right angles to its length, while it revolved uniformly round one of its extremities. This surface is easily constructed mechanically thus: take a rectangular parallelogram A B C D (*Fig.* 7) of the width of nine inches, or as wide as the intended furrow, and of a length equal to four times the width. Bisect B C in E and D C in F; at F raise a perpendicular F G to the plane of the rectangle, and make it equal to C E. Join E G and produce it to K, making F K equal to F E. Join K D. Draw from every point in C D lines at right angles to C D, meeting the line E K in different points: these lines will form the required surface. The line K D will be found inclined 45° to the horizon at the angle K D H, which is the inclination at which the furrow-slice is most advantageously laid. To those who are not familiar with solid geometry, these lines may be easily exhibited by means of a wire inserted at E and bent at a right angle at K, inserting the bent portion into the board A B C D (*Fig.* 8) at D, so that it shall be inclined 45° at D, lying in the direction of E K in *Figs.* 7 and 8. Care must be taken that G F be equal to C E and perpendicular to the board.

Fig. 7.

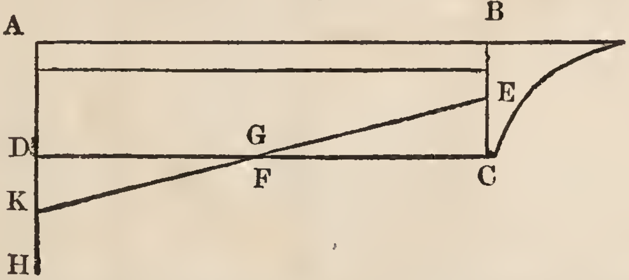
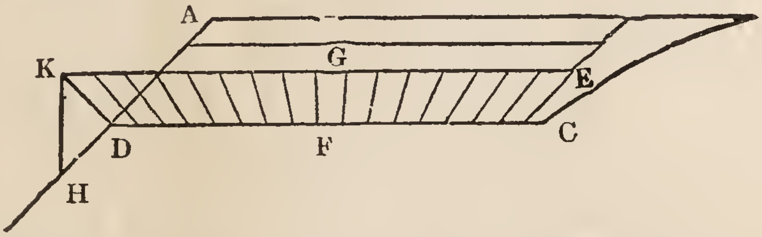


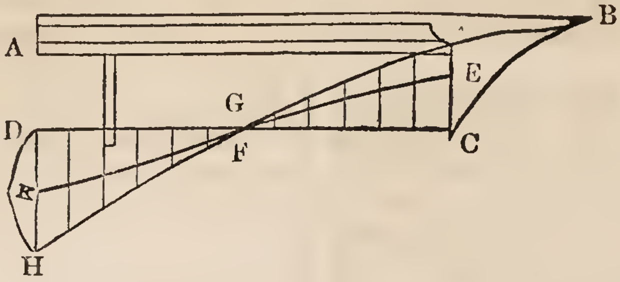
Fig. 8.



It is evident that, as the plough moves on, a particle at E will slide along the line E K, become at G perpendicular to the bottom of the turn-furrow, which should be parallel to the sole, and at K be at an angle of 45° with that line. If the slice were a solid substance, this line E K would be all that is required to turn it in its proper position; but as the soil is generally loose, and would crumble to pieces, a support must be given to it by a surface at least as wide as the slice. This surface is generated by drawing lines from different parts of D C at right angles to this line, and meeting the line K E (*Fig.* 9). These lines will be at different angles to the horizon, nearly horizontal at C, where the fin of the point begins perpendicular at F, and at 45° beyond it at D. The curve thus generated will be found to turn over soils of a moderate tenacity very perfectly. If it is very light, the surface may be formed by arcs of circles with a considerable diameter, the concave part upwards; if it is very tenacious, the convex part of the arches may be upwards. Thus the surface may be varied without altering the fixed line E K. The annexed figures (10, 11, 12) will explain this. The distance of the perpendicular F G from the fin of the share may also be varied, either lengthening or shortening the turn-furrow, as experience may show to be most advantageous.

Horizontal Plan of the Plough.

Fig. 9.



A B, the Sole. C, the Fin. D C, the bottom of the Turn-Furrow.

Sections of the three different turn-furrows, at different distances from the heel.

Fig. 10.

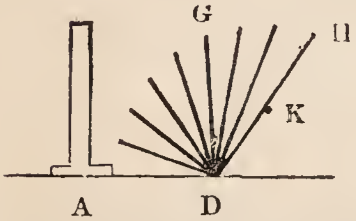


Fig. 11.

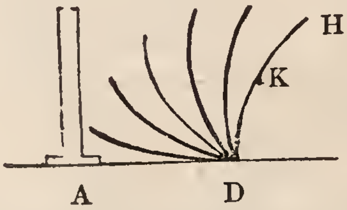
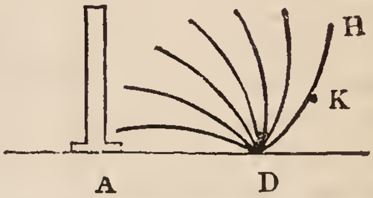


Fig. 12.



A plough has lately been constructed on this principle by Messrs. Ransom of Ipswich, at the suggestion of the writer of this article, and exhibited at the meeting of the Royal Agricultural Society of England, held at Cambridge, July 15, 1840. It promises to realise the expectations formed of it. In soils of a loose mellow nature it answers completely, and does the work more perfectly than any other plough. It unites the parallelism of the sole and bottom of the turn-furrow of the Flemish plough with the improved shape of the turn-furrow. By adopting the variations in the shape of the turn-furrow which we have suggested, this plough may be adapted to any soil, and be used with or without wheels.

Ploughs were formerly made of wood, having those parts covered with iron where the greatest friction takes place, the share and coulter only being of iron; but in consequence of the greater facility of casting iron in modern times, most of the parts are now made of this metal. The beam and stilts are still usually of wood, but even these are now sometimes made of wrought-iron. The advantages of iron are, its durability and the smaller friction it occasions when once polished by use. The inconveniences are, the additional weight of the instrument, and consequent greater friction of the sole. Recent experiments have proved this to be greater than was generally suspected. A great improvement has been introduced by making the points of the shares of cast-iron, which, by a mode of casting the lower surface on a plate of metal, makes one surface much harder than the other; and as the softer surface wears more rapidly, a sharp edge is always preserved.

The different parts of a plough are now usually cast, so that if any one fails or wears out, it can be instantly replaced, by moving a few screws or bolts. This is a very great saving of time and expense; for before this, every time an accident happened to any part of the plough, it took a long time to repair it, and in the mean time the labour was suspended, often at a very critical time of the year. There is another advantage in having the essential parts of cast-iron. If any particular shape has been once discovered to be the best for any part, that shape is preserved without deviation in every plough made on the same pattern, and with respect to the turn-furrow this is of the greatest importance.

The stilts of the plough are mostly of wood. Where the soil is light and crumbling, without stones, as in Norfolk, a single handle or stilt is sufficient; but where some force is occasionally required to prevent stones or other obstacles from turning the plough out of its course, two stilts are most convenient, placed at a more obtuse angle with the sole of the plough.

The force required to draw a plough depends not only on the nature of the soil, but also on the shape of the plough, and especially on the position of its different parts with respect to each other, so that they do not counteract each other.

If a plough were drawn in the direction of the sole, the obliquity of the turn-furrow would cause it to turn towards one side, and it would require a considerable force to keep it straight. In order to prevent this, the line of draught is placed at an angle, which varies with that of the turn-furrow and the force required to push the furrow-slice over. To adjust this angle, so as to cause the plough to keep in the intended line, there is a contrivance at the end of the beam to change the position of the ring by which the plough is drawn to the right or left of the line of the beam, and another by which it may be raised or lowered. In most ploughs the beam, having been originally set at a small angle with the sole towards the right, has an arch of wood or iron at the end, as in the annexed *Fig.* 13. An iron, shaped as in *Fig.* 14, is made to embrace the beam, to which it is attached by a pin (*a*), round which it turns as a centre. Another pin (*b*) passes through one of the holes in the circular end, and keeps the iron in any required position to the right or left of the line of the beam. The end of this iron, which is called a bridle, has several projecting hooks in the oblong curve which terminates it, on which an iron ring is hung at different heights. By these contrivances the plough may be drawn from a point on either side of the beam, and higher or lower as may be required. When the plough is found to *take too much land*, as ploughmen say, that is, tends to increase the width of the slice cut off by the coulter, the bridle is shifted to the left by moving the pin (*b*) into another hole: when it goes *out of the land*, as it is called, that is, diminishes the width of the furrow-slice, the pin is moved a hole or two to the right, until the plough has no tendency to deviate to either side. If it inclines to rise out of the ground, the ring is shifted in the iron bridle and placed in a hook or notch higher up; if, on the contrary, it dips too deep, the ring is hooked lower. Thus a plough may be made to go straight and at a regular depth, without any more force being applied to the stilts than is required to counteract inequalities in the land, or accidental obstacles, such as stones or roots, which might throw the plough out of the ground. When the soil is of unequal texture, it is useful to have a small wheel connected with the fore part of the beam, so as to prevent its dipping downwards, which would require a great pressure on the stilts to keep the point of the share up, and thus increase the friction of the sole on the ground, and

Fig. 13.

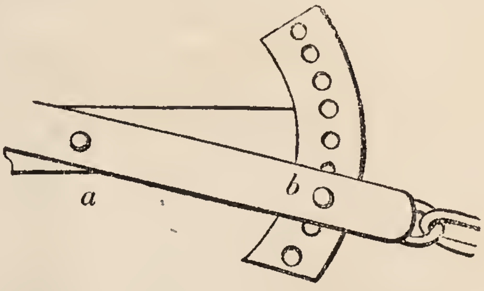


Fig. 14.

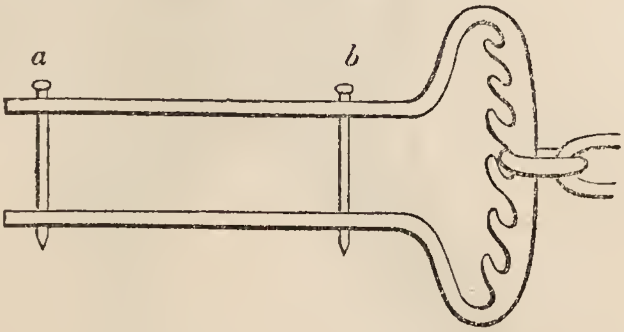
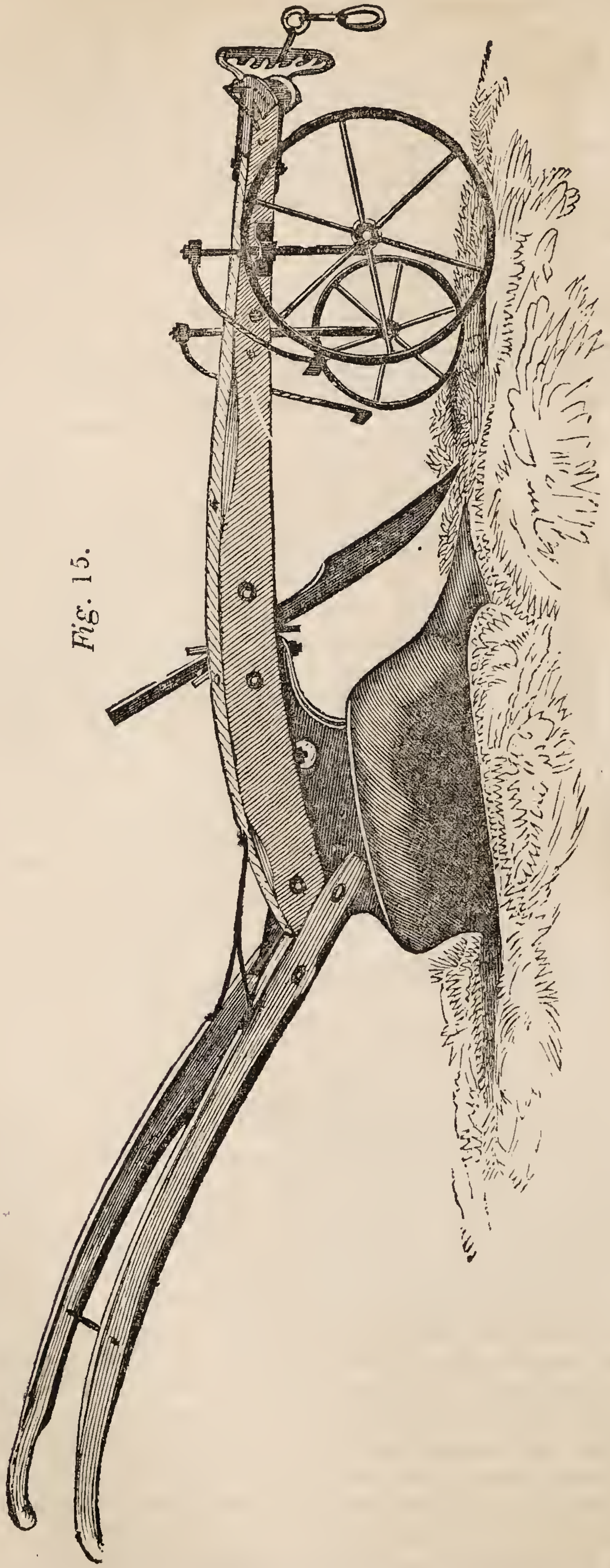


Fig. 15.



Ransom's Rutland Plough.

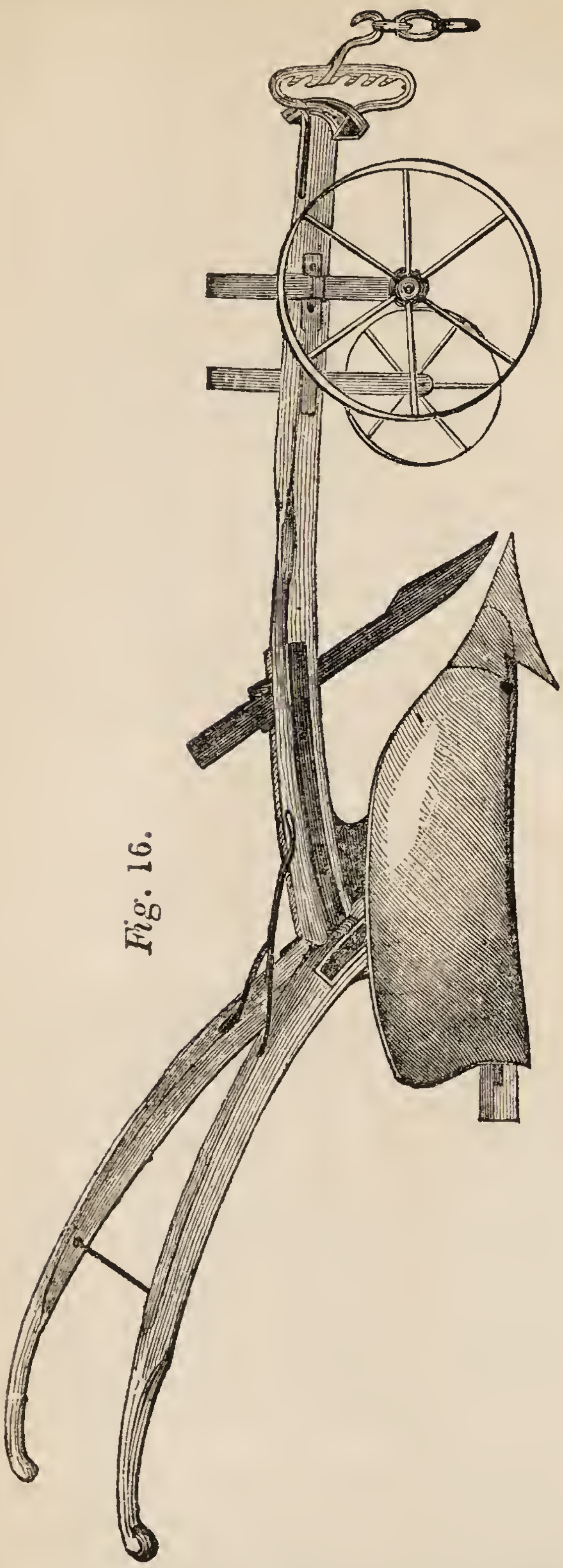


Fig. 16.

Bedfordshire Plough with Wheels.

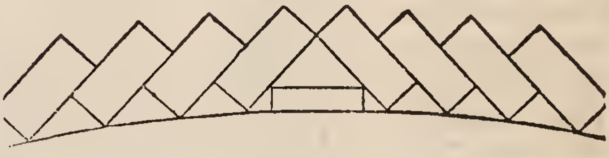
consequently the labour of the horses. In the Rutland and Bedford ploughs two wheels are connected with the beam, one of which runs in the furrow to the right, and the other on the unploughed soil to the left. When the plough has been well adjusted, and the larger wheel runs in the angle of the furrow, it acts as a gauge to regulate the width of the slice as well as its depth: in very uniform soils without stones, the plough, when set in the proper direction, will make a very straight and even furrow parallel to the one in which the wheel runs, without any person holding the stilts; so that all that is required is to turn the plough at the end of each furrow, and set it into the proper line to form the next. As this admits of a very correct adjustment, no unnecessary force is required to draw the plough: and hence this plough appears to be the easiest for the horses; and if the wheels are not very heavy, and the plough is of a good form, it certainly requires less power to move it than many which are without wheels; and it is far superior to the old clumsy wheel-plough, the beam of which rests on a heavy carriage, without being firmly attached to it. This, instead of lessening the draught, increases it by all the pressure of the beam upon the carriage, besides the weight of this last and of the wheels. There are some very irregular and stony soils, where a common swing-plough can scarcely be kept steady without the help of wheels, and where it would not be so convenient to have the beam fixed on the wheels. In this case a separate carriage is necessary, that the ploughman may have a fulcrum on which he can raise his plough, or turn it to either side to avoid any considerable stone or other obstacle. As a general rule, it may be safely asserted that a slight but strong swing-plough, in the hands of a clever ploughman,—with one wheel in particular soils, but, in general, without any wheel,—will effect its purpose with the greatest precision, and the least exertion of the horses drawing it. Theory and practice agree in this; and if any experiments appear to throw a doubt upon it, we shall probably find some circumstances which have influenced the result, when wheel-ploughs have appeared to require the least power of draught. But wheels have one advantage—they will enable an inferior ploughman to make better work than he could possibly do without them; and that too with less labour to the horses, because, from his want of skill, the swing-plough would be continually subject to sudden deviations, requiring him to use his strength to counteract them; and each exertion of the ploughman adds to the labour of the horses.

Some interesting experiments have been made on the draught of different ploughs by Mr. Handley, late M.P. for Lincolnshire, and Mr. Pusey, M.P. for Berkshire, which are detailed in the third and fourth numbers of the Journal of the Royal Agricultural Society.

Without entering into any comparison of ploughs differently constructed, it is evident that the shape of the plough must vary with the nature of the soil which it is to turn up. A light soil must be shovelled up; a mellow one may be turned over with any kind of mould-board; a very stiff tenacious soil which adheres to any surface pressed against it, will be more easily turned over by a few points of contact which do not allow of adhesion. Hence the point and turn-furrow have been made of all imaginable shapes, and while one man contends for a very concave form, another will admit of nothing which is not very convex. That plough will no doubt have the least draught which is best suited to the soil which it has to move. The lighter the plough is, consistently with sufficient strength, the less draught it requires, all other circumstances remaining the same. Lightness and strength combined are consequently great advantages, and if a very light plough does its work as well as a heavier, there can be no doubt that it is preferable. Durability is nothing compared with the saving of one horse in three: it is cheaper to have a new plough every year than to keep an additional horse all the year. If a wooden plough is found to be more easily moved than an iron one, there can be no doubt which should be preferred.

The Flemish plough is made of wood, and is very light; the share and coulter only are of iron, besides a thin sheet of iron over the mould-board. which is shaped as if it had been rolled obliquely over a cylinder, a shape well adapted to sandy soils. In ploughing land which is more or less mellow and crumbling, the great object is to bring to the surface that portion which has lain buried, and has not served to nourish the preceding crop, and to bury that which has produced vegetation, and in which the roots of various weeds have established themselves. When manure is to be covered with a certain depth of earth, a more complete subversion is required, in order that no part of it may remain uncovered. When the land is in a compact state, from the roots which pervade it, and it is only ploughed once to prepare it for receiving the seed, much greater nicety is required to lay the slices at a certain angle so as to leave regular lines or depressions in which the seed may fall and be readily covered by the harrows which follow. In this case the angle of 45° is found to be the most convenient at which the furrow-slices may be laid against one another. The field will then have the appearance of being laid in small ridges as in the annexed figure, all towards the same side if ploughed with a turn-wrest plough, or towards a middle line if a plough with a fixed turn-furrow has been used. To produce this regularity, the end of the turn-furrow is made to press on the slice turned over; and some ploughmen fix a piece of wood or iron to the end of the turn-furrow, which makes a groove in the furrow-slice at the place where the next one will be laid upon it. This prevents useless openings between the slices. It adds no doubt to the draught, but it makes better and neater work.

Fig. 17.

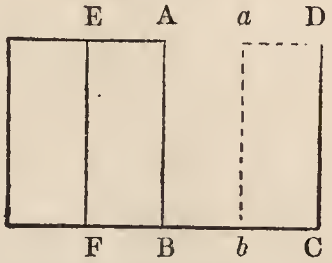


When the seed is to be dibbled on the sward, which is reversed by a single ploughing, it is necessary that the sod should be completely turned over and laid flat. To do this, and at the same time to bury all the grass, requires the furrows to be very equal and parallel; so that when a roller has gone over the land, it is perfectly flat, without any interstices between the slices which are turned over. It requires a good ploughman to do this perfectly.

When clover-ley or old grass is ploughed up, it is difficult to bury all the grass which grows on the edge of the slice; and if it remains exposed, it will grow and increase to the detriment of the corn. To prevent this, a wing is sometimes added to the side of the coulter, a few inches from the point. It cuts a small horizontal slice off the surface before the sod is turned over, and this falls into the bottom of the furrow and is buried there. The coulter with such a wing is called a skim-coulter, because it, as it were, skims the surface. This instrument may require an additional horse to be put to the plough in tenacious soils, but this cannot be avoided. There is no doubt that no more horses should be put to a plough than can do the work; but whatever be the number required, the work must be done well. There is no saving in doing the work imperfectly. The discussions about the number of horses which should draw a plough might easily be settled, if the nature of the soil were sufficiently taken into consideration. The shape of the plough may make some difference, but the tenacity of the soil makes a much greater. It is however not a little surprising that there should be so little variety in the width of the furrows. It would appear as if there were a law prohibiting furrows less than eight inches wide, or more than ten: a furrow-slice five inches wide and ten deep requires no more power than one ten inches wide and five deep. It is true that a plough will not do more than half an acre at most in a day with narrow furrows; but if two horses will do this, and two ploughs instead of one be used, with one man and two horses each, an acre will be ploughed in a day with four horses and two men, which is the number usually employed, when the furrows are deep and nine or ten inches wide; but the land will be much better stirred, and laid more even. The Romans ploughed with deep narrow furrows, and varied the width purposely, the better to pulverise the soil. The plough need not be narrower for this work; for if the first furrow be made wide enough, the plough can deepen it by a second turn in it, and a trench is formed in which the next slice falls, and is pushed aside by the tail of the turn-furrows, so as to leave another trench open ten inches wide.

Suppose ABCD (*Fig.* 18) the section of the first wide furrow, and a slice AEFB is cut off the solid side of the land half the width of the trench; the mouldboard pushes this earth, after it has been turned over, into the space DC*ab*, marked with the dotted line, and in doing so beats and crumbles it, leaving a fresh trench *ab*FE equal to the first, and so the whole field may be ploughed without difficulty. In nine cases out of ten, where the soil is properly cultivated, and ploughed in a proper state, this mode of ploughing would be found a great improvement, and equal to a trench ploughing, or subsoil ploughing. Where the farms are small and few horses are kept, deep ploughing is not practicable with the usual width of furrow; but with a narrow furrow, the land may be moved to a very great depth with a couple of horses. The plough must be made sharp and narrow, and the turn-furrow not much curved, so as rather to push the earth aside than to lift it.

Fig. 18.



Very little attention was formerly paid to the straightness of the furrows. It was natural to follow the shape of the boundary of the field, which was seldom straight; and this practice increased gradually till no straight furrow was to be seen; and there was a prejudice, if not a superstition, in favour of crooked ridges. Those who defended them with the least vehemence, asserted that if crooked furrows were not better than the straight, the difference was unimportant; but no curves can be laid so perfectly parallel as two straight lines. Every deviation from parallelism causes a defect in the contact of the slices, and a loss of force by the obliquity of the draught. A superficial observer would not perceive this, but minute examination proves it. Hence equal and straight furrows are a sign of good ploughing.

When the land lies on a dry subsoil, and no more moisture remains in it, after continued rains, than is useful to promote vegetation, it may be ploughed quite flat. This may be done by a plough with a moveable turn-furrow, or by ploughing in a continued spiral from the centre to the circumference, or the reverse. In this case straight furrows cannot be made. The best way is to draw a furrow the whole length of the field in the middle, and plough towards this from both sides. If the field is wide, it is most convenient to plough it into several broad stitches, each a certain number of perches in breadth. A perch (16½ feet) is a very common width for a stitch, and convenient to guide the sower or the drilling-machine.

But on moist impervious subsoils, it is necessary to lay the land in a rounded form, in order to let the superfluous water run off into furrows, from which it is conducted by proper channels into the ditches. In this case half a perch is a common width for each stitch, or land, as it is sometimes called. It requires some practice to lay up a land in a rounded form from a flat surface. After cross-ploughing and harrowing, the first furrow is drawn wide and shallow, and the earth is thrown upon the surface to the right: when the plough returns, it takes another furrow about nine or ten inches from the first, laying the earth or furrow-slice somewhat obliquely over the first. At the next turn another slice is laid, meeting the last at an angle, the first slice being quite covered by the two last. This now forms the crown of the ridge; and the succeeding slices are laid obliquely, leaning to the right and left, till the required width is obtained. Another land is now begun at the distance of a quarter of a perch from the last furrow, and laid exactly in the same manner.

Fig. 19.

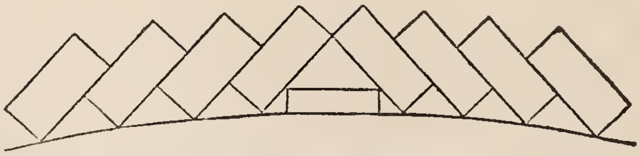
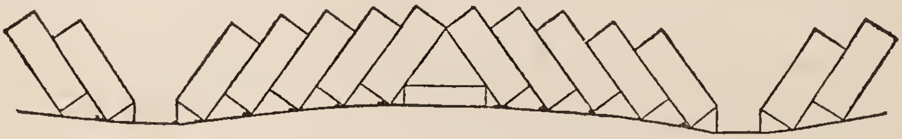


Fig. 20.



When the two lands meet, the intervening furrow, which had been purposely left shallower, is deepened; and there is a furrow between every two lands, the bottom of which is considerably below the bottom of the other furrows. When this field is ploughed again after harvest, the work is reversed; the furrow between the lands is filled with the first slice, and another is placed over this, which now becomes the crown of the land to be formed: this is called ploughing crown and furrow. When the lands are ploughed towards the crown, it is called gathering. By gathering several times in succession, the soil is much raised at the crown, at the expense of the sides. This was the old practice, when lands were laid very wide and very high; in common fields, the land or stitch was often the whole width of the possession, from which came the name of land. In Scotland they are called rigs.

One of the most useful operations in ploughing land is to cross the former furrows, by which means the whole soil is much more completely stirred; and if any part has been left solid without being moved by the plough-share, which is called a balk, it is now necessarily moved. The leaving of balks is a great fault, and is owing to the sole of the plough being narrower than the furrow-slice, and the wing of the point too short, or to the ploughman not holding his plough upright. The share should cut the ground to the whole width of the furrow, that no roots of thistles, docks, or other large weeds may escape and grow up again. The Roman authors recommended the use of a sharp rod or stake inserted horizontally into the ground, to discover if there were any balks, which, with their ploughs, must have been often left, if the ploughman was not very careful to make close and small furrows. Many ploughmen hold the plough in an oblique position; the bottom of the furrow is consequently not level, and the soil is not stirred equally. This is a great fault, especially in wet ground; for the furrows thus become channels in which the water remains, not being able to run over the inequalities of the bottom. It is of no use to lay the surface convex, if the solid earth below lies in hollows or gutters. The water naturally sinks down into the newly-ploughed land, till it meets the solid bottom which the plough has gone over; if it can run over this into the deeper furrows between the stitches, it evaporates or runs off, and the land is left dry, and so consolidated as to let the water run along the surface without sinking to any depth; but if the bottom is uneven, it remains in the hollows, and stagnates there, to the great injury of the growing crops.

There are various modes of ploughing land when it is intended to pulverise and expose it to the sun in summer, or the frost in winter, to purify and fertilise it. To expose as great a surface as possible, the whole field is laid in high and narrow ridges, bringing to the surface all the fertile portion of the soil, and often also a portion of the subsoil, so as to deepen the productive portion and give more room for the roots to spread in. The simplest method of increasing the surface exposed, when the land is first broken up from pasture, or after having been some years in grass, and is in a foul state, is called ribbing. The plough turns up a slice, which it lays over flat on the adjoining surface. It does not cover this with the next slice, as if it were beginning the crown of a stitch, but it takes another slice at some distance, and then one parallel to the first, likewise laid flat on the solid part. When the whole field has been so ploughed, the surface consists altogether of ridges and furrows; but only half the surface has been ploughed. No grass appears; if it has been well done, the unploughed strips being covered by the slices raised by the sides of them, the two surfaces with grass on them cover each other. It is left in this state till the grass is rotten, and when the sod is broken to pieces by heavy drag-harrows, the land can be cross-ploughed and cleaned or fallowed in dry weather.

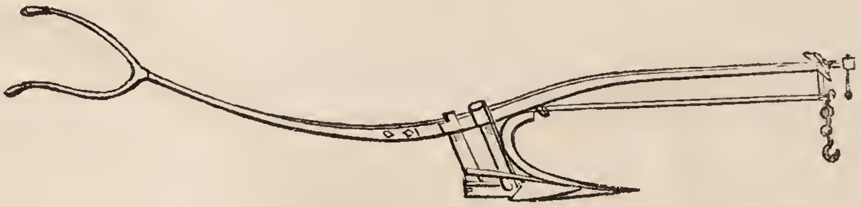
There is another mode of ridging, when the land has had one or two ploughings, in order to expose it to the frost in winter, and to mellow it. The operation is somewhat similar to ribbing, but after the first slice is turned over, another is added, as deep as the plough can be made to go so as not to bring up the subsoil; by this means the whole surface is laid in high ridges and deep furrows; and when this ploughing is reversed, in spring, the soil which has been exposed to the frost and wind is mixed with the rest, and tends greatly to mellow it. This is an excellent preparation for turnips, if the land has been well cleaned. The manure, being distributed in the deep furrows, is covered by the plough right and left, or at one operation by a plough with a turn-furrow on each side, which divides the ridge and lays half of it in each contiguous furrow. This plough is usually called a double mould-board plough, and is extremely useful in many operations of husbandry.

In order to save hands and expedite the tillage of the land, ploughs have been contrived which make two or more furrows at once. When they are well-constructed, they are very useful on light soils. If it is not required to go deep, and two horses can draw a double plough, there is a decided saving of power; but if it requires four horses, nothing is gained. The double ploughs are therefore not much in use. But there are instruments which cultivate the earth, stirring and pulverising it much more speedily than the plough. Some of these will stir the ground to the depth of seven or eight inches, going over a width of five or six feet at once. Such an instrument is preferable to the plough, after the ground has already had a certain degree of stirring, and is become mellow and crumbling; but to break up pasture or clover-ley, there is nothing so efficacious as the plough, which cuts regular slices and lays them over, so that all the grass shall rot, and the roots, being exposed to the air, shall decay, and thus furnish food for other crops.

The instruments which have been invented to save the time and labour required by repeated ploughings are very numerous. Some of the most useful have been noticed before. [Arable Land.] New ones are daily invented, and some are supported by wheels, which render them both lighter and more convenient. They are easily raised out of the ground, when not intended to work, and the depth to which they are let down is more easily regulated.

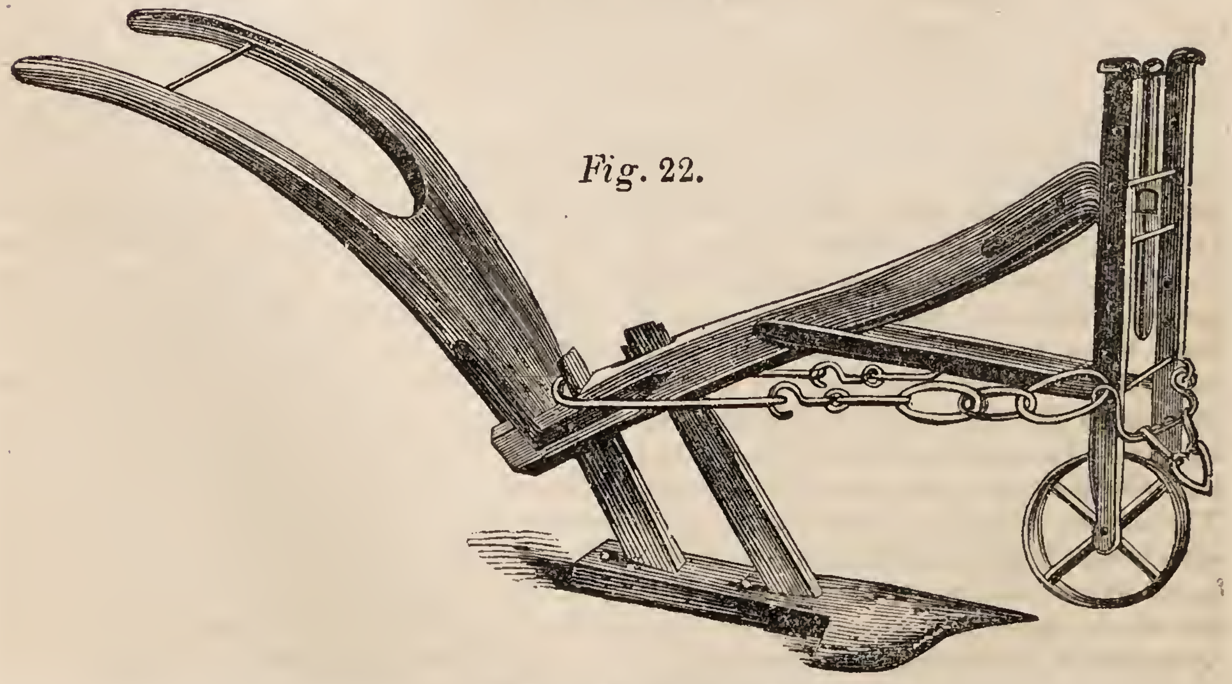
Deep ploughing is generally acknowledged to accord with the best husbandry, where the subsoil is dry naturally, or has been artificially drained; but some inconvenience may arise from bringing a bar ren subsoil to the surface, in trench-ploughing by two ploughs following each other in the same furrow. It has therefore been suggested to take off the turn-furrow from the plough which follows the first, so as to stir the subsoil without bringing it to the surface. [Arable Land.] This idea has been improved upon by constructing a subsoil-plough of great strength, which will go very deep into the ground and stir the subsoil a foot or more below the bottom of the usual furrow. Mr. Smith of Deanstone has invented one made entirely of iron, and Sir E. Stracey has constructed another with a small wheel in front very strongly put together, although the beam is of wood. It is of somewhat lighter draught than Mr. Smith's, but it does not go quite so deep. This plough requires four horses in the most favourable soils, and six in tenacious clays, to keep up with the common plough, which always should precede it.

Fig. 21.



Smith's Subsoil Plough.

Fig. 22.



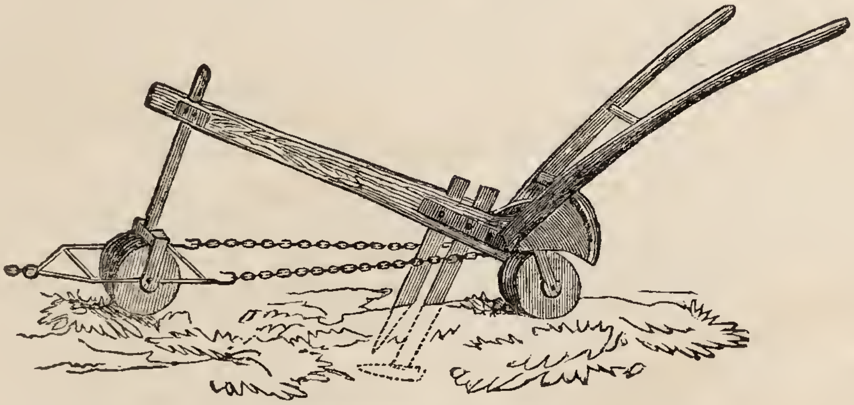
Stracey's Rackheath Plough.

Sometimes however the subsoil-plough may be used alone, where the surface is already mellow and crumbling. The figure of each of these ploughs, represented on page 404, requires little explanation when the purpose for which they are used is understood.

Many different ploughs have been invented for the purpose of saving labour in draining land. As they all cut out a slice from the bottom of a furrow and raise it up to the surface of the ground, they are of little use in crumbling soils, and in the most tenacious require the assistance of much manual labour to complete the work. They act on the principle of the carpenter's tool by which a groove is formed in the edge of planks or deals, when they are intended to be joined closely as in a floor. This instrument is also called a plough; but the uniform tenacity of the wood allows a narrow chisel to cut an even regular groove. In the draining-plough the two sides of the drain are to be cut obliquely downwards and the bottom scooped out evenly. The plough requires to be often adjusted, and the deep furrows to be kept cleared from loose earth by means of spades and scoops. In this way drains may be made from 15 to 18 inches deep, in which loose stones or tiles may be laid to form a channel for the water. The expense is much less than when the drains are made with the spade.

When grass-land lies low and wet on a very tenacious subsoil, a plough is sometimes used which consists of a cylinder of iron pointed at one end, and connected with a strong beam by a thick plate of iron, which is sharp on the side nearest the point of the cylinder, and acts as a coulter. This instrument is forcibly drawn horizontally through the stiff subsoil at a depth of 12 to 18 inches, so as to leave a round channel like a pipe where the cylinder has passed. This has been called a mole-plough, the passage made by it under ground resembling the workings of a mole. It takes six horses to draw this plough, when the cylinder is 15 inches under the surface, but is the most easy and expeditious means of temporarily draining land. It can only be done when the soil is moist and gives way without cracking, but at that time the feet of the horses greatly damage the surface. In consequence of this a windlass with a long chain has been invented. The drum, which is vertical, and round which the chain is coiled, is turned by a horse who walks round and round, while the whole apparatus is kept in its piace by means of an anchor fixed in the ground. It draws the mole-plough the length of the chain, and is then moved forward on small wheels while the chain uncoils. As soon as the chain is all off the drum, the anchor is refixed and the operation continues. This mode of draining land has now been almost entirely superseded by a more regular and permanent system of draining with stones or tiles. The channels made by the mole-plough are very apt to fill up in dry weather; and the mole takes advantage of a ready-made passage to work in it, stopping it purposely to retain water and to form its

Fig. 23.



Lumbert's Mole-Plough.

nest. When this is the case, the water rises to the surface and does much harm. Nothing but a fresh application of the mole-plough parallel to the old channels can remedy this evil.

Various ploughs have been constructed with the intention of diminishing the draught, or improving the form of the turn-furrow; but most of them without much regard to scientific principles, merely from a vague notion founded on some real or supposed defect in the ploughs in common use, or in order to adapt them to particular soils and situation. It would be useless to take notice of many of them, which have but little merit, and are not generally approved of. At the meeting of the Royal Agricultural Society at Cambridge in 1840, Messrs. Ransom, of Ipswich, exhibited no less than eighty-two differently constructed ploughs, giving an excellent opportunity to those who wished to compare the principles on which they are constructed, and the manner in which these principles are applied.

POLLARDS are trees which have had their tops repeatedly cut off for the sake of the faggot-wood, which is used for burning and heating baker's ovens. The appearance of an old pollard may, in particular situations, be thought picturesque, but nothing can be more unsightly in a landscape than rows of pollards bordering every inclosure, as is seen in some countries. It is only in the case of a few trees of quick growth, such as willows and poplars, that there is a profit in making pollards of them. To have oak, ash, and elm polled, which if left to grow would in time produce valuable timber, is a very great loss to the proprietor of the land, and but little profit to the tenant. Supposing an oak polled when twenty years old, and lopped every ten years after, there will be seven loppings only, worth a few shillings each, in the first century; whereas the oak, if left to acquire the age of one hundred years, would have afforded excellent timber for ship-building, and produced five times as much money as all the loppings put together. It is usual to allow tenants to lop such trees as have been lopped before, but it would be much more profitable to all parties if the pollards were all rooted up, and a few timber-trees planted at considerable distances from each other in the hedgerows. Where wood is required for fuel, it is better to plant a good coppice interspersed with timber-trees; and if this be done judiciously on good sound land, the quantity taken from the farm for this purpose will be as profitable as if it had been kept in cultivation. Trees are often planted in soils which are not worth cultivating; and hence the profit from a good coppice is usually underrated; but if the damage done to the land by the roots and shade of trees be taken into the account, it will be found that it is more profitable to have the wood growing by itself.

On the margin of low rivers running through marshy grounds, it may be profitable to plant willows, poplars, and other soft-wooded and rapidly-growing trees, in order to lop them at stated intervals. Their timber would be of little value if they were left in their natural state; but being lopped every seventh year, they produce rods and faggots, which are readily disposed of. Hence the common saying that "a willow will buy a horse before an oak will buy the saddle."

To manage pollards advantageously, the head of the tree should be cut off at a moderate height while the tree is young, and the shoots which spring from the crown must be frequently cut off before they begin to branch out. Thus a good head is formed, throwing out many shoots, which may then be left to grow till they are of a useful size. The willow takes root so readily, that if a branch twelve or fourteen feet long is put two feet into the ground, it will grow, and form a tree at once, which after a few loppings will become a pollard.

If the appearance of rows of pollards is unsightly, the cutting the side branches of trees in hedgerows, leaving only a little tuft at the top, is much worse. No branch above ten feet from the ground should ever be permitted to be cut by a tenant, nor the top of any tree to be cut off in order to make a pollard of it, and a clause to that effect, with a severe penalty, should be inserted in every lease.

POTATO (*Solanum tuberosum*, Lin.). The circumstances which led to the introduction of this valuable vegetable into the system of British husbandry may be thus succinctly stated:—

Queen Elizabeth, in 1584, granted a patent "for discovering and planting new countries not possessed by Christians;" and under this sanction some ships, principally equipped by Sir Walter Raleigh, sailed with him to America. Thomas Harriott (afterwards known as a mathematician), who accompanied the adventurous squadron, transmitted to England the description of a plant called *Openawk* by the natives of that part of North America which the courtier-like gallantry of Raleigh had named Virginia.

Harriott described the *Openawk* as having the roots round, and "hanging together as if fixed on ropes, and good for food, either boiled or roasted." Gerarde, in his 'Herbal,' a few years subsequently, distinguished the plant by a plate; and not only confirmed the assertion that it was an indigenous production of Virginia, whence he himself had obtained it, but supplied some curious details of its qualities, and of the various modes in which it may be dressed for the table. He especially recommended it as the basis of "delicate conserves and restorative sweetmeats," with the assurance that its flatulent effects may be infallibly corrected by having the roots "eaten sopped in wine;" adding, "to give them the greater grace in eating, they should be boiled with prunes."

The honour of first cultivating the potato in Ireland, where it has so long constituted the principal food of the peasantry, has been attributed to the grandfather of Sir Robert Southwell, president of the Royal Society of London, towards the close of the seventeenth century. Sir Robert's statement was to the effect that his ancestor had obtained some roots from Sir Walter Raleigh. The well-known story of Raleigh's having first planted the potato in his garden at Youghal, and of the disappointment of the gardener in autumn on tasting the apples of the "fine American fruit," and of his subsequent discovery of the tubers, when he was desired by his master to throw out "the useless weeds," is probably authentic also.

But the potato had been known in Spain and Portugal at an earlier period, and it is from the latter country that we most directly derive the name by which we know it: this is easily shown. Although the natives of North America called our plant openawk, those of the south, more particularly the inhabitants of the mountains of Quito, called it papas, which the Spaniards corrupted into battata: this again their neighbours in Portugal softened into ba-ta-ta (da terra), to which po-ta-to is a very close approximation.

The potato was cultivated in Ireland long before its introduction into Lancashire, which was owing to a shipwreck, it is said, at North Meols, at the mouth of the Ribble, where the mode of propagation still maintains pre-eminence, and whence the culture of this important plant has gradually spread through every portion of Great Britain.

It was not, however, until after a considerable time that it became palatable, productive, and farinaceous, or admitted into the course of field husbandry. It was limited to the garden for at least a century and a half after it was first planted at Youghal, and it was not until 1732 cultivated as a field crop in Scotland. It appears (from the 'General Report of Scotland') that in the year 1725-6 the few potato plants then existing in gardens about Edinburgh were left in the same spot of ground from year to year, as recommended by Evelyn: a few tubers were perhaps removed for use in the autumn, and the parent plants were well covered with litter, to save them from the winter's frost.

A strange objection to potatoes was urged by the Puritans, who denied the lawfulness of eating them, because they are not mentioned in the Bible; but whether we view this vegetable with reference to its adaptation to every soil and almost every climate, or as a great source of food and nutritive properties, it must be ranked among the best gifts of Providence.

Though the plant may be propagated both by its seed and tubers, practical management has confined the cultivation to the latter mode, except for the purpose of raising new varieties or renewing old ones. Those who are curious about varieties (which are now innumerable), can almost indefinitely pursue their object; for the seed of a species, the red apple for example, will sport, and this too without hybridizing (that is, without the admixture of its seed with that of any other species, the produce of which would be hybrids) into numberless varieties of form and colour—round, flat, oblong, red, pink, black, white, mixed, and purple, of every shade and colour. These, whether hybrids or not, are reproduced through successive seasons by the tubers alone, if they possess those qualities which render them desirable for continued cultivation, on account of peculiar adaptation to early or late seasons, size, predominance of farina, &c.*

This mode of propagation by tubers either improves those qualities or gradually develops objectionable properties. Some varieties are therefore permanently established, while the culture of others is either abandoned, or, if continued, it is known that those varieties revert in the course of a few generations to the nature of their parent kind, and therefore cease to constitute a variety.

In the vegetable kingdom, hybrid plants have not the power of propagation by seed; but they can be rendered reproductive by budding and grafting, or by means of cuttings, slips, and tubers, and an original stock comparatively worthless may be highly improved by such modes of multiplication. But when a farmer possesses two or three kinds of decided excellence, he will act wisely by not encumbering his stores with too many varieties, which always occasion trouble and confusion in the field management.

In order to obtain seed, properly so called, the potato-apple, when perfectly ripe, should be dried, and then disengaged from its seed by rubbing with the hand. The seed should be preserved in a dry place, in paper or cloth bags, until the middle of March or beginning of April, when it may be sown in wooden boxes or earthen pans, with a covering of less than half an inch of well pulverised earth. The vessels ought then to be placed in hotbeds of mild heat, such as is suited to the raising of half-hardy annuals. The plants, when an inch high, should be pricked out into other vessels, and placed in a temperature somewhat lower than before, to inure them to the external air, to which they should be exposed after frosts have ceased. These plants should be put out in drills sixteen inches apart, and with the interval of six inches between the plants in the rows. They will produce tubers in the first year, and these may be planted in the following season in the ordinary way.

For very early crops, such as those which the ash-leaved and walnut-leaved kinds in particular yield, the most successful treatment was that practised by the late Mr. Knight, president of the London Horticultural Society, from the course of whose practice we give the following details of instruction:—Drills may be formed in a warm and sheltered situation (and in the direction of north and south) during any of the winter months, two feet apart, and seven or eight inches deep. Stable dung, half decomposed, should be laid in the drills and combined with the earth four inches downwards, and covered with some of the mould, which had been thrown out in forming the drills, by the rake, to within four inches of the surface. The sets uncut are then to be placed, with the crown eye uppermost, in the centre of the furrow, four inches from each other, and to be covered with only an inch of mould at first, and afterwards with an occasional quantity of sifted ashes, until the plants are so vigorous and advanced as to require the usual earthing, of which, however, very little is necessary. Mr. Knight used leaves as a lining at the sides of the drills in the early periods, to preserve as much warmth as possible, and better to guard against the effects of frost.

This management alone will be found

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* M. Sargeret, a distinguished and accurate French experimentalist, referred to in the 'Dictionnaire d'Agriculture,' found that out of 300 varieties he had not one exactly like the original from which they were raised; and out of this great number he only found three worth perpetuating.

successful, except perhaps in very tenacious clay soil, in which the rains of winter may lodge so near the fibres of the plants as to destroy them altogether; but destruction from this cause may easily be avoided by increasing the original depth of the furrows and loosening the bed of clay below with the spade to such a depth as will allow the water to descend from the surface, with a drain to carry it off altogether; or by laying below some absorbent matter, such as ashes, chalk, or calcareous gravel.

The germination of the sets may be accelerated by a little management previously to their being planted, by laying them on a floor, sprinkling them with water until they bud, and then covering them with finely-sifted mould. If this be done in December or early in January, the sets, with strong shoots, may be taken up in February (with as much earth as possible adhering to them), and carefully placed in the drills prepared as directed, and covered with well-rotted leaves or earth in the same way.

To market-gardeners it is a great object to raise the earliest potatoes, considering the high price which they obtain for them, though in their waxy state they are neither wholesome nor palatable. Next in early maturity to the ash-leaved and walnut-leaved are the early Manly and early Champion and Fox's seedling.

The best soil for potatoes generally is that which is altogether fresh from the state of ley, or which has not long been broken up: land which has been in grass for only two or three years is easily prepared for the principal crop. It should be as deeply ploughed as possible before winter, and early in March harrowed, and thoroughly cross-ploughed. After lying in this state for two or three weeks, it should again be well harrowed and very deeply ploughed twice, without bringing up any bad substratum, and it will then be fit for the reception of the crop.

The most approved modes of setting are as follows:—Drills should be formed in the well-pulverised field, with double boutings of the plough, in order to have the shoulders uniform, which is essential to the correctness of succeeding operations. The dung is then to be carted out, and divided by the carter with a drag-fork as his horse and cart move forwards (the horse walking in the centre of three drills while the wheels move in the other two), in such quantities as can be most conveniently shaken out into the drills by the labourers employed to spread it. In dry weather the carting does no injury, and this method is universal in Scotland. The other principal mode, more generally pursued in Ireland by some of the best cultivators of the potato, is to cart out the manure before the drills are formed, in rows seven or eight yards apart, and to supply the drills from the heaps as the plough advances in its work, reserving just as much as is supposed sufficient for the concluding drills, which are to be made in the sections of the field previously occupied by the rows of manure. By the latter treatment the manure may be laid over the sets—which cannot be done in the former case—and this will preserve them from being displaced or crushed by the feet of the horses during the process of covering the seed. But against this advantage—which is not inconsiderable—there is the inconvenience of calculating with precision and laying aside as the plough advances to draw the last drills—where the rows had stood—the precise complement of manure, and the difficulty to the ploughman of preserving the exact breadth in those drills.

Some avoid any perplexities in those respects by ploughing in the manure thoroughly before drilling, and either dropping the set in every third furrow, or rolling the whole manured and ploughed surface, and then making drills. Our own experience is greatly in favour of this latter mode, when the fertilising matter is abundant and of the short description which freely combines with the soil, and does not obstruct the plough in the subsequent drilling. The lazy-bed method is so generally condemned that any explanation of it here would be superfluous, yet in undrained bog-land, or under any circumstances in which a redundancy of wetness is probable in the autumn, as on low marshy lands, or stiff clay soils which have no sufficient inclination to carry off the water, and are likely to be saturated with moisture in winter from want of drainage, the lazy-bed system is by far the safest. The deep wide furrows at each side carry off the water, or at least remove it from the potato. Thousands of tons of potatoes in the year 1839 were utterly lost in Ireland, being drilled in flat and tenacious lands, which would have escaped destruction from the continued rains of that season if drained by the furrow of the lazy-bed. Besides, where circumstances preclude the practicability of deep ploughing, the lazy-bed practice repeated for three years will completely spade-trench the entire land, and thus effect an important benefit not otherwise attainable by the humble tiller of the soil who has no teams for ploughing it effectually. Thus local or national modes, though apparently defective to the superficial observer, are sometimes founded upon sound principles, and though we feel disposed to exclude the minute details of what is only defensible under peculiar circumstances from an essay on potato culture under our modern system, we protest against the unqualified condemnation of a method which is still pursued throughout nearly one half of Ireland.

The sets (uncut, for reasons to be yet assigned) are next to be laid down, either under or over the manure, at the average distance of sixteen inches, by the setters, who move in a retrograde direction, and are provided with aprons to contain the sets. A sufficient number of men is in attendance to divide the manure evenly in the drills; the plough also is in the field in order that there may be the least possible exposure of the manure and sets to the sun or to parching wind, but the plough should cover the sets rather lightly in clay soil.

The roller is next used to lay an even surface to the brairding* plants, and to facilitate the subsequent progress of the paring plough, which is to be set to work when the stems are six or seven inches high, and should move as close to the plants as is practicable without injuring their tender fibres. The weeders should then hoe the plants carefully, and immediately afterwards (for the influence of wind or hot air on the roots is pernicious) the scuffler or drill-harrow is to follow, in order to clean and level the intervals, before the earthing plough, with either double or single mould-board, is introduced to apply fresh earth to the stems.

Such is the method of earthing universally pursued by the farmer in Ireland and Scotland, but in England the hand-hoe is principally used for destroying weeds, loosening the earth, and moulding the plants; for the two first of these operations the bean-hoe (which cuts about six inches deep) is used, and the turnip-hoe for drawing the earth to the stems. One man will hoe out the weeds and loosen the soil of half an acre per day, and the subsequent earthing of the same quantity is also executed by one man. This is far cheaper than horse-work, and it does no injury to any of the stems, and makes no waste land at the headriggs; and where the earth has been perfectly well prepared at the commencement, this manual husbandry is the best.

If this system be found most effectual in England, where the wages of a labourer are 2*s*. a day, it must be far more so in Ireland, where they are but half that amount, and where practice would soon give sufficient dexterity in the use of the hoe.

As to the distance between the drills, due regard must be had to the natural quality of the soil and the quantity and description of manure available, or in other words, to the probable luxuriance of foliage. Mr. Knight, aware of the necessity of allowing room in proportion to the vigour and height of the plants, has laid down an exact rule thus:—"The height of the stems being three feet, the rows ought to be four feet apart:" but for a general average, thirty inches is the best distance. As to excess of foliage we are certain that it is not desirable, for the produce of tubers is not always in proportion to the degree of foliage; under high and rank stems there it often a very scanty crop, and Mr. Knight is justified by experience in his observation that "the largest produce will be obtained from varieties of rather early habits and rather low stature, there being in very tall plants much time lost in conveying the nutriment from the soil to the leaves," and consequently strong and upright stems, which do not fall down and shade the others, are those which are desirable.

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* A Scotch term signifying 'shooting out.'

Two more earthings are usually given, but it is questionable whether even one be necessary in soil of average depth, unless there be a very wide interval between the drills, and it is certain that much earthing in dry and shallow soil is injurious; for by withdrawing the earth from contiguity to the fibres which ramify and penetrate far in loose soil, and laying it on the head of the drill, and in the high ridgelet form, it is applied where it is useless for the nourishment of the tubers, and in a position that favours the rapid escape of moisture, which in such soil it ought to be an object to retain. In deep land, more particularly if it be of tenacious quality, the furrows at each side of the drill will be in general seasons most serviceable as drains, as well as for furnishing earth to support the stems, while the moisture will be sufficiently retained for the roots.

Experiments* have led to the inference that in soil of a loose porous quality there is probably a greater produce by not affording any (or a very slight) moulding, but by digging instead between the rows; for deep and perfect pulverization, next to an adequate allowance of rich manure, is the main cause of a large produce. In proportion to the deficiency of manure will be the necessity for opening the soil beneath, to allow the fibres, which may be distinctly traced to a depth incredible to those who have not followed their ramifications, to extract all the nourishment which the subsoil may afford. If there be an abundance of nutriment above, neither the necessity nor perhaps the inclination for penetrating deeply can exist, and in such cases the operation of earthing by the plough, as long as it can be introduced without injury to the stems, may be useful in many ways, but unquestionably by guarding them from the effects of storm in exposed, and from excessive wetness in low situations. Besides, in regulating this point, regard should always be had to the quality of the potato, for the tubers of some varieties have a tendency to push to the surface, while others tend into the earth, and therefore require a different treatment.

But in all cases the earth should be rendered as loose and friable as possible, by spade, hoe,* or plough, and where labour is easily commanded, the spade will be found to be the more efficacious implement in the first course of treatment after the plants are well up.

Some plant one or two sets in the centre of every square yard, but in such cases great and continued earthing, until each square presents the form of a pyramid, is contemplated; and if our preceding remarks be correct, this treatment is only applicable to deep and retentive soils. Great returns have no doubt been thus obtained, but by this mode there is the least possible incorporation of the manure with the soil.

In minute husbandry, such as that exemplified in labourers' allotments, which excludes the plough altogether, the ordinary and best practice is to lay the sets in rows, after a very deep winter digging, marked with a garden-line. The workman digs precisely as in a garden-plot for cabbages: he clears a little drill, lays the sets straight, puts a sufficiency of manure over them, and then covers from the next spit, which he digs with a spade or a three-pronged fork flattened at the ends, levelling and pulverising as he advances to the distance at which he again puts down his line and forms a new drill. Thus the entire piece is thoroughly loosened, the manure perfectly covered, and every facility given for the hand-hoeing in due course.

The next stage of the potato is that in which it blossoms. It has been recommended to pluck off the flowers. Excessive blossoming is no doubt injurious, but experience has generally proved that the extra cost is hardly defrayed by the additional produce obtained. If the flowers are plucked off, they should be nipped in the early bud.

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* See Martin Doyle's 'Cyclopædia of Practical Husbandry,' page 372.

* That kind called the bean-hoe, shaped like an adze.

When the crop is fully ripe, which is indicated by the withering of the stalks, and when the land is free from stones, labourers, in the proportion of about twenty to one plough (half of these being usually men, and the remainder women or young persons), should be set to pull up the stalks, and carefully collect the tubers which may be attached to them, before the plough proceeds in its operation. When it is prepared for work, the men, with prongs flattened at the extremity, are placed at such distances from each other as will give them proper time to fork out the potatoes cleanly for the pickers, who are also stationed at exact distances with a basket between every pair, into which they gather the potatoes.

The common swing-plough may be employed in three ways: — First, in taking off a slice from each side of every drill, and leaving it to the workmen to open out the centre with their prongs; or in its third movement it may turn up this centre, under which the main body of the tubers lie, which is more expeditiously and easily done if the earth be in fit condition. Second, a double mould-board plough with a long sack, and divested of its coulter, may be drawn by two strong horses through the centre of the drills, and completely under the level of the tubers, so as to avoid injuring them, by which means the work-people will be kept exceedingly busy; and if the land be in good friable order, this is the most expeditious mode, and provided there is a perfect harrowing afterwards, the crop will be taken out with sufficient cleanliness. Third, the crop may be taken up by prongs or long narrow spades without the plough. In wet weather this more tedious but far safer method is frequently adopted, and if the drills be short and the headriggs under crop also, it is the most desirable, effectual, and economical mode. In removing the produce in this manner, it is obvious that the number of gatherers should be much less in proportion to the men, than under the other circumstances. The headriggs should evidently be the first parts of the field cleared, to make a free space for the ploughs in the boutings and for the carts.

One horse will answer for three carts if the distance of draught to the pits be short, by changing him alternately from an empty to a full one, but this only applies to the Scotch and Irish system of draught by single carts and horses. The general mode of securing the crop in pits in the field is the safest. In making the pits—improperly so termed, for the base is only sunk a few inches, and the potatoes are raised considerably in the heaps —the only caution to be observed is that furrows should be cut on all sides to prevent water from lodging or penetrating inwards, and that the earth thrown up and over them to the depth of four or five inches, should be well beaten with spade or shovel to exclude moisture and frost. The potato-stalks, however apparently dry, should never be laid between the potatoes and the earth in these accumulations, for they soon ferment and rot, and injure all the potatoes in contact with them. Straw is at least useless. The length of the pit depends on circumstances, but the breadth should not exceed four feet, as large accumulations are most liable to fermentations.

The only decided disease of the potato, besides the dry rot, is 'the curl,' which is an imperfect formation, and was first generally observed in 1764, when it gave rise to various conjectures and unprofitable discussions: the cause is yet unknown. One thing however is clear, that from a crop of which any part is intended for seed, all the plants affected with curl should be carefully separated before the general removal commences. The dry rot, or decay of the set, which during recent years so fearfully prevailed in many parts of the United Kingdom, is also still unexplained as to its real cause, though the press has teemed with essays and very plausible theories respecting it. The same malady was remarked for many years, as appears by the 'Philosophical Transactions of the Bath Society,' and we have reason to think, in seasons similar to those which we have experienced in latter years. The set, though apparently sound when planted, has either failed to germinate at all and rotted away, or has feebly and partially thrown out its sickly shoots. The most contradictory causes have been assigned: over-ripening in the preceding year; under-ripening; fermentation in the pits; fermentation of the set in the ground when placed in contact with hot dung (which is utterly absurd, for when in the ground no injurious fermentation can arise); very hot weather, great drought, hot sun, cold parching wind, dry and heating manure, sea-ware, which is always damp; exhaustion of the kind from a long course of culture, contradicted by many instances in which it appears that the produce of the same variety—for instance the apple —has been successively cultivated during sixty-five years without any failure; or the loss of vitality from prematurely shooting.

If potatoes have fermented in their accumulated state, they would bear obvious evidence of it, and therefore be rejected. Fermentation cannot be the true cause in every or even the majority of cases, nor does the failure probably proceed from insects in the eyes, as has been suggested, for if so, it is difficult to account for the fact that sets from the same heap planted at one part of the day have totally failed, while others put into the ground at another have pushed forth healthy shoots. As to decay in the land from the contiguity of fermenting manure, "How is it to be proved that the gases evolved by fermenting manure can injure the sets? Fermenting manures would rather stimulate by their warmth, and excite their growth by the aliment which their essential qualities, carbon and ammonia, supply to plants. Why do not the gaseous exhalations from rank and fermenting hot-beds destroy the tender plants which are raised in them?" (Doyle's *Cyclopædia of Practical Husbandry.*)

The same causes which are severally assigned for the total or partial failure of the potato in numberless instances, and to a most distressing extent in Ireland, have existed since the culture of the potato commenced, but without the effects deplored, which have only prevailed within a very recent space of time. But from the frequent and searching investigation of the subject by the most competent and practical men, a preventive against the failure has been ascertained, namely, the planting of entire tubers. When the cut sets have failed, the entire tubers have resisted premature decay; whether it arises from atmospheric influence or debility of constitution, or from any of the conjectured causes, the entire tubers resist these noxious influences, and germinate healthily and freely. All reports agree on this point: there is no risk in this case, if the tubers be sound when planted; and it may be added, that in all stages of their growth, the uncut tubers maintain a decided superiority and yield a corresponding produce.

The farina of the potato, properly granulated and dried, is sold in our shops as tapioca, to which it bears the closest resemblance both in appearance and essential properties. For confectionary the flour is so delicately white, and it is so digestible and nutritious, that it ought to be in more general use, among the children of the poor especially, in the winter season, when they so rarely enjoy the luxury of milk; and the cost is not more than a sixth or seventh of the price of tapioca or arrow-root, if it be made at home. Few housewives are ignorant of the method of obtaining it by the use of a common hand-grater and sieve; but for yielding larger supplies some machinery is necessary.

POULTRY, from the French *poulet*. The term includes all the domesticated birds reared for the table; fowls, turkeys, geese, ducks, and Guinea fowls.

Fowls.—"The strong and ambulatorial feet of the gallinaceous birds adapted to the region where they chiefly resort for their food and the purposes of incubation; their toes and nails peculiarly formed for scratching up the grains and seeds which constitute the main part of their subsistence; their short wings and the weakness of their pectoral muscles, which cause the heaviness of their flight, a deficiency which is counterbalanced by the strength of those muscles of the thighs and legs that contribute to their powers of running; their gregarious, and, generally speaking, polygamous habits; the ease with which they are domesticated; their wholesome flesh; together with many striking peculiarities in their anatomy, serve equally to distinguish them."*

Some foreign varieties have not even the rudiment of a tail, while others are distinguished by it. The game cock, which is probably a native of India, though for many centuries established in England, has an unusual length of spur, his natural weapon of combat. The flesh of this variety is delicately white and of the finest flavour, the plumage brilliant, and the form symmetrical; but from their pugnacious temper, there is great difficulty in rearing even those of the same brood; and for companionship with the general inmates of the fowl-yard they are very exceptionable for the same cause. So pugnacious however are the males of almost every variety, that they will spur even before their spurs are grown. For the natural history and peculiarities of the various varieties, we refer to works on natural history: we shall merely notice in this place the kinds suited to the purposes of the farmer.

The best breed of the gallinaceous fowls is the produce of the Dorking (Surrey) cock and the common dunghill fowl. This cross is larger and plumper, and more hardy than the pure Dorking, without losing delicacy of flavour or whiteness of flesh.

The characteristics of the pure Dorking are, that it is white-feathered, short-legged, and an excellent layer. The peculiarity of this established variety, which has frequently five claws perfectly articulated (with sometimes a sixth springing laterally from the fifth, but always imperfect), is well known. The crossing with the Sussex fowl has however greatly diminished the monstrosity in the Surrey pentadactylus variety. But though the true Dorking, which is white, is much esteemed, that colour is rare, and prized for the ornament of the poultry-yard: speckled colours are most generally seen with the higgler.

The Poland breed, which is black-feathered, with white topknots, lays well, and is highly desirable where the production of eggs for the table is the principal object; but they seldom sit, though they cannot be considered long-legged.

The Chittagong, or Malay, which is a very large Indian variety, is generally long-legged, with yellow body and coarse yellow flesh. Fanciers used to like them for their fine appearance and their large eggs; but as their long legs incapacitate them from steady sitting, they are not general favourites. One of our practical acquaintances recommends the male produce of the Poland and Chittagong as a good cross with the common dunghill hen, as their progeny will sit.

Parmentier thus describes the cock:—

"He is considered to have every requisite quality when he is of a good middling size; when he carries his head high; has a quick animated look, a strong and shrill voice, short bill, a fine red comb, shining as if varnished; wattles of a large size, and of the same colour as the comb; the breast broad; the wings strong; the plumage black, or of an obscure red; the thighs very muscular; the legs thick, and furnished with strong spurs; the claws rather bent, and sharply pointed. He ought also to be free in his motions, to crow frequently, and to scratch the ground often in search of worms, not so much for himself as to treat his hens. He ought withal to be brisk, spirited, ardent, and ready in caressing the hens; quick in defending them, attentive in soliciting them to eat, in keeping them together, and in assembling them at night." *

Those who intend to rear fowls or any kind of poultry on a large scale, should have a distinct yard, perfectly sheltered, and with a warm aspect, well fenced, secure from thieves and vermin, and sufficiently inclined to be always dry, and supplied with sand or ashes for the cocks and hens to roll in, an operation necessary to disengage their feathers from vermin: running water should be especially provided; for the want of water, of which all poultry are fond, produces constipation of the bowels and inflammatory diseases; and for geese and ducks, bathing is an indispensable luxury. A contiguous field is also necessary for free exercise, as well as for the supply of grubs and grass to the geese. The fowl-house should be dry, well-roofed, and fronting the east or south, and, if practicable, at the back of a stove or stables; warmth being conducive to health and laying, though extreme heat has the contrary effect. It should be furnished with two small lattice windows, that can be opened or shut at pleasure, at opposite ends, for ventilation, which is frequently necessary; and the perches should be so arranged, that one row of roosting fowls should not be directly above another.

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* Vigors, 'Linneau Transactions,' p. 402.

* Translated by Mr. Dickson, author of an excellent work on poultry.

M. Parmentier has shown * by what arrangement a house twenty feet long and twelve feet wide may be made to accommodate 150 hens at roost. The plan is simply this :—the first roosting-perch (rounded a little at the upper angles only, for gallinaceous fowls cannot keep a firm hold on perfectly cylindrical supporters) should be placed lengthways, and rest on tressels in each end wall, six feet from the front wall, and at a convenient height, which must depend on the elevation of the house from the floor, which should be formed of some well consolidated material that can be easily swept. Another perch should be fixed ladder-ways (*en échelon*) above this, but ten inches nearer to the back wall, and so on, until there are four of these perches, like the steps of a ladder when properly inclined, but with a sufficient distance between the wall and the upper one to allow the poultry-maid to stand conveniently upon when she has occasion to examine the nests, which it is her duty to do every day at least once, and in the forenoon. The highest of these she can reach by standing on a stool or step-ladder. By this contrivance the hens, when desirous of reaching the nests, have no occasion to fly, but merely to pass from one stick to another. If the size and form of the house permit, a similar construction may be made on the opposite side, care being taken to leave an open space in the middle of the room, and a sufficiently wide passage for the attendant to pass along the walls. It is not at all required to have as many nests as hens, because they have not all occasion to occupy them at the same time; and besides, they are so far from having a repugnance to lay in a common receptacle, that the sight of an egg stimulates them to lay. It is however true that the most secluded and darkest nests are those which the hens prefer.

The nests, if built into the wall, are in tiers from the bottom to the top, the lowest being about three feet from the ground, and a foot square. If the laying-chambers consist of wooden boxes, they are usually furnished with a ledge, which is very convenient for the hens when rising.

But the best receptacles for the eggs are those of basket-work, as they are cool in summer, and can easily be removed and washed. They ought to be fastened not directly to the wall, as is generally the case, but to boards fixed in it by hooks, well clinched, and with a little roof to cover the rows of baskets. They will thus be isolated, to the great satisfaction of the hen, which delights in the absence of all disturbing influences when laying. All the ranges of nests should be placed cheque-wise, in order that the inmates, when coming out, may not startle those immediately under: those designed for hatching should be near the ground (where instinct teaches the hen to choose her seat), and so arranged that the hens can easily enter them without disturbing the eggs.

Wheaten or rye straw is the most approved material for the bedding, being cooler than hay: the hens are sometimes so tortured by lice as to forsake their nests altogether, in an agony of restlessness. A Dorking housewife has assured us that she once lost an entire clutch, from having, as she believes, given a bed of hay-seeds to her sitting hen. The chicks were all glued to the shells, and thus destroyed, owing, as she thinks, to the high temperature occasioned by the fermenting seeds.

For all purposes two cocks in a good run are considered in the poultry counties contiguous to London as sufficient for twelve or fourteen hens, but in France they allow twenty mistresses to each cock, which no doubt is on account of the higher temperature there. In a confined yard, five hens are sufficient for one cock in our cold country, and a double set will not answer in very limited space. When there are two or more cocks, care should be taken not to have them of equal age or size, for in this case they are always jealous and quarrelsome; if one is decidedly ascendant, the other will never presume to dispute with him. It will be judicious also to avoid the introduction or changing of cocks in the breeding season, for the hens require constant intercourse with them, and several days frequently elapse before they become familiarised with a stranger. The best way is to bring in the new cock in the summer, either as a chick, or late in the year in the moulting season, when he will not take too much notice of the hens. As a general rule it would be well to have one a yearling and the other a year older. In the third year, the cock, who then becomes lazy and excessively jealous, should be killed.

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* 'Dictionnaire d'Agriculture.'

In order to have the earliest chickens, hens should be induced to sit in October, which they may do if they have moulted early. By attention in this particular, chickens can be brought to the market at Christmas. But the object should be in general to set the eggs as soon as possible after Christmas, in order to have chickens with the forced asparagus in March, when they are worth in London from 7*s.* to 10*s.* a couple.

In selecting eggs for hatching, care should be taken that they are not at the utmost more than a month old, but their condition for hatching will greatly depend upon the temperature of the weather: vitality continues longest when the air is cool.

It has been asserted that the future sex of the bird is indicated by the shape of the egg; the round producing the female, and the oblong the male. But this is contradicted, and, we believe, with sufficient reason, and it is impossible not only to foretell the sex, but even to ascertain whether the egg be fecundated. This however is certain, that if the air-bag (at the obtuse end), which has been mistaken for the germ, and the purpose of which is to oxygenate * the blood of the chick, be perforated even in the least conceivable degree, the generating power is lost altogether. Those eggs only which have been fecundated by the male are possessed of the vital principle. The number of eggs for a hen should not exceed sixteen, as she cannot impart the necessary warmth to more. It is by no means uncommon with experienced breeders to place two hens on the same day on their respective eggs, and then on the twenty-first day, when the broods are out, to give the maternal charge of both to one of the hens, removing the other to another set of eggs, which, if she be a steady setter, she will hatch as in the first instance. This however must be deemed a cruelty, though some hens would instinctively continue to sit until death. They would however become so attenuated by continued sitting, as to lose the power of communicating to the eggs the necessary degree of warmth. The practice of the Surrey breeders is to feed the hen on oats while sitting, as less stimulating than barley, which they give to the laying hens on account of this very quality.

Some fanciers use artificial mothers, which effect the purpose of imparting the necessary heat to the young chicks after birth, when there is no natural mother nor a trained capon to brood them. These artificial mothers—as used by Mr. Moubray, and described by him—are boxes lined throughout with wool. He recommends that a curtain of flannel should be suspended over the opening of the box for the exclusion of cold air.

Mr. Young states that "five broods may at once be cherished under an artificial mother. This mother may be framed of a board ten inches broad and fifteen inches long, resting on two legs in front, two inches in height, and on two props behind, two inches also in height. The board must be perforated with many small gimlet-holes, for the escape of the heated air, and lined with lamb's skin dressed with the wool on, and the woolly side is to come in contact with the chickens. Over three of these mothers a wicker basket is to be placed for the protection of the chickens, four feet long, two feet broad, and fourteen inches high, with a lid open, a wooden sliding bottom to draw out for cleaning, and a long narrow trough along the front, resting on two very low stools, for holding their food. Perches are to be fixed in the basket for the more advanced to roost on. A flannel curtain is to be placed in front, and at both ends of the mothers, for the chickens to run under, from which they soon learn to push outwards and inwards. These mothers, with the wicker baskets over them, are to be placed against a hot wall, at the back of the kitchen fire, or in any other warm situation where the heat shall not exceed 80 degrees of Fahrenheit.

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* See the 'Domestic Habits of Birds' in the 'Library of Entertaining Knowledge,' p. 115.

"When the chickens are a week old, they are to be carried with the mother to a grass-plat for feeding, and kept warm by a tin tube filled with hot water, which will continue sufficiently warm for about three hours, when the hot water is to be renewed. Towards the evening the mothers are to be again placed against the hot wall."

The artificial mother, however, is only a mechanical house for chicks already hatched; but the process of bringing the embryo of organised life in the egg through all the stages of the vital principle until it becomes matured, by means of heated ovens, has been long and successfully practised in Egypt.

These ovens, which are constructed with bricks, are about nine feet high, with galleries extending through the whole length, and containing chambers into which a man can creep through a very contracted orifice for the purpose of depositing the eggs, which are laid, to the amount of several thousands, on mats or beds of flax over the brick floors. The heat is conveyed through fire-places, and the material of the slow fires, which are most effective, is the dung of cows or camels combined with straw. The fires are kept up for as many days (according to the temperature of the weather) as are sufficient to impart such a degree of heat as will continue to the expiration of the twenty-one days required for the hatching of chickens, care being taken to confine the warmth by closing up all the orifices communicating with the external air.* One hundred millions of chickens are said to be thus annually produced in Egypt.

M. Réaumur made various experiments in hatching with fermenting dung in hotbeds, but unsuccessfully; life was developed, but never matured; the chicks were in some cases even feathered, but long before the full time they lost vitality. He succeeded at length, "after trials enough to wear out the most enduring patience," with an oven free from the influence of the vapour exhaled from the dung, which in the previous experiments had been destructive of the embryo. He afterwards succeeded to a great degree by using a box or shelves over an oven, with due regard to uniformity of temperature. Several of the eggs in this latter case were hatched on the twentieth day, by which the usual course of nature was anticipated by one day. But though artificial hatching has long been practised with success in Egypt, it has not been found worth the expense and trouble in France, from the variableness of temperature there compared with that in the Delta, where, in the autumnal season, when the mamals (hatching-ovens) are used, it is remarkably steady and extremely warm.

Since the attempt to pursue the Oriental system has failed in France, there is no probability of its succeeding in the climate of Great Britain; but it by no means follows that success may not attend such management as will obviate the obstructions which arise from irregularities of temperature. The object was partially attained some years ago by means of steam, but uniformity of heat was not preserved, and consequently that experiment failed. It would appear, however, that the application of the Eccaleobion† machinery exhibited in London by Mr. Bucknell, the inventor and proprietor, may be successful. Mr.

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* For the details and statistics on this interesting subject see the 'Domestic Habits of Birds,' *Library of Entertaining Knowledge*, p. 138.

† From Ἐκκαλέω, 'I call forth,' and Βίος, 'life.'

Bucknell asserts that his eccaleobion possesses a perfect and absolute command over temperature from 300 degrees of Fahrenheit to that of cold water; so that any substance submitted to its influence shall uniformly be acted upon over its whole surface at any required intermediate degree within the above range, and such heat maintained unaltered, without trouble or difficulty, for any length of time, and that "by means of this absolute and complete command over the temperature obtained by this machine, the impregnated egg of any bird, not stale, placed within its influence at the proper degree of warmth, is, at the expiration of its natural time, elicited into life, without the possibility of failure, which is sometimes the case with eggs subjected to the caprice of their natural parent."

That chickens are thus hatched in considerable numbers is unquestionable, upwards of thirty thousand having been already brought into existence by this single eccaleobion machine; nor has any difficulty been found in the subsequent rearing of those chickens when proper yards and suitable temperature were provided, more than in the natural way; indeed in some respects less so, as the losses sustained in poultry by the sudden changes of the weather, and the influence of dampness in particular, and accidents from various causes, are very considerable. Supposing Mr. Bucknell's experiment to answer the purpose in every respect, the increase in the production of poultry might be rendered incalculably great by the adoption of his principle on a great scale, wherever the essentials of a dry soil, warmth, and proper buildings can at the same time be supplied.

"It must have struck even the most superficial observer, that the extraordinary fecundity of gallinaceous fowls is a wise and most benevolent dispensation of nature to provide the more abundantly food for man, as in those tribes of birds not suited for his table the female lays no more eggs than she can incubate. With respect, therefore, to domestic poultry, the most nutritious of all human food, this rich provision of a bounteous providence is for the first time available to Europe."*

The eccaleobion machine, capable of containing 2000 eggs, resembles an oblong box, nine feet in length, three feet in breadth, and the same in height. It has no connection with the walls, against which it is placed on the table on which it stands; its regulating power is within.†

The following striking passage from Mr. Bucknell's work 'On Artificial Incubation,' above alluded to, will show the importance of this subject in its commercial and domestic bearings.

Mr. Bucknell observes (p. 16), "We call the Egyptians barbarous: the procuring, however, by art and industry, an abundant supply of that necessary of life, good animal food, is no evidence of barbarism. If the population of the United Kingdom, which as respects Egypt is as twenty-four to two, were as well supplied with this artificial production as Egypt, it would require, not ninety-two millions, but one thousand one hundred and four millions of poultry annually, for them to be as well fed in this respect as the uncivilised natives of Egypt. But how stands the account in this matter? Full one-third of our population subsist almost entirely, or rather starve, upon potatoes alone; another third have, in addition to this edible, oaten or inferior wheaten bread, with one or two meals of fat pork, or the refuse of the shambles, per week; while a considerable majority of the remaining third seldom are able to procure an ample daily supply of good butcher's meat, or obtain the luxury of poultry from year to year.

"On the continent of Europe the population is still in a worse condition:—fish, soups made from herbs, a stuff called bread, made from every variety of grain, black, brown, hard, and sour, such as no Englishman could eat; olives, chestnuts, the pulpy saccharine fruits, roots, stalks, and leaves, and not unfrequently the bark of trees; saw-dust, blubber, train-oil, with frogs and snails, make up and constitute a good part of the food of the greater portion of the inhabitants of Europe. There is no other cause for this than the excessive ignorance of its population."

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* 'Treatise on Artificial Incubation,' by W. Bucknell, Esq., p. 36.

† Ibid.

The contemplation of the progressive stages through which life is developed and matured in the egg, is highly interesting. The contents of the shells, of the species under immediate consideration, taken out and placed on a plate or a saucer on Mr. Bucknell's table, present the following appearances, according to the respective periods:—

On the third day, the embryo organization of the skull, brain, heart, and blood is perceptible by the aid of a magnifying glass.

Fourth day. The pulsation of the heart is distinguishable by the naked eye.

Sixth day. The chief vessels and organs rudimentally formed; the pulsation and circulation of blood apparent.

Ninth day. Intestines and veins formed, and the deposition of flesh and bony substance commenced; the beak for the first time open.

Twelfth day. The feathers have protruded, the skull has become cartilaginous, and the first voluntary movement of the chick is made.

Fifteenth day. Organs, vessels, bones, feathers, closely approaching in appearance to the natural state.

Eighteenth day. Vital mechanism nearly developed, and the first sign of life heard from the piping chick.

Twenty-first day. The chick breaks the shell, and in two or three hours is quite active and lively.

The exit of the chick from the shell is assuredly one of the most interesting processes of animated nature ever investigated by naturalists. It was supposed that the mother bird broke the shell; but M. Réaumur has long since detailed the processes, and we ourselves have witnessed the evolution of the chick in the eccaleobion by its own unassisted efforts. The French naturalist to whom we have just now referred thus explains some interesting facts:—"I have seen chicks continue at work for two days together. Some again work incessantly; others take rest at intervals, according to their physical strength. I have observed some in consequence of their impatience to see the light, begin to break the shell a great deal too soon; for they ought, before they make their exit, to have within them provision enough to serve for twenty-four hours without taking food, and for this purpose the unconsumed portion of the yolk enters through the navel. The chick, indeed, which comes out of the shell before taking up all the yolk is certain to droop and die a few days after it is hatched. The help which I have occasionally tried to give to several of them towards their deliverance has afforded me an opportunity of observing those which had begun to break their shells before this was accomplished; and I have opened many eggs much fractured, in each of which the chick had as yet much of the yolk not absorbed. Besides, some chicks have greater obstacles to overcome than others, since all shells are not of an equal thickness nor of an equal consistence; and I think it probable that the same inequality takes place in the lining membrane. The shells of the eggs of birds of various species are of a thickness proportional to the strength of the chick that is obliged to break through them."*

If the chick should be glued to the shell, as sometimes occurs, and is indicated by the faintness of its chip, and the non-enlargement of the fracture for some hours, it must be assisted (but not until the necessity is fully ascertained) in its liberation "with a key, or some such instrument, and by cutting the membrane with the points of a pair of scissors. The operation, though painful to the chick, does not prove mortal; for it is no sooner freed than it exhibits as much vigour as any other chick of its age."† But unless the chick, after a full day's effort, is found unable to chip the shell, from weakness or adhesion to its envelope, it is better not to assist it in its extrication; for in ninety-nine cases out of a hundred aid proves ineffectual, through the injury inflicted upon the delicate organization of the bird; or more probably the previous weakness or imperfection of the chick, which occasioned the necessity for assistance, also occasions its death at the moment of its birth, and would take place even if its disengagement were effected without any injury.

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* 'Domestic Habits of Birds,' *Library of Entertaining Knowledge.*

† Ibid.

There is a caution to be observed in all cases regarding the eggs when the chicks are on the verge of maturity: they should not be stirred when within two days of the evolvement of the chicks. If any circumstances render it absolutely necessary to do so, care should be taken to place them with the broad end inclining upwards, as the beak of the chick is then in its proper position; and if this be reversed, the chick becomes unable to chip the shell, and must therefore die.

Chickens should be fed the day after their birth with crumbs of bread soaked in milk, or with the yolk of an egg boiled hard; and they will quickly learn to eat curds, grits, and barley-meal and milk. If not designed for immediate use, they should soon get raw corn, and occasionally alteratives of green food, such as bruised leeks, nettles, lettuces, &c. For the first week they should be confined to the house altogether; after that time they may be let out for a short time in the sun, and gradually habituated to the weather. To render the hen, which has already discharged her duty, still more productive to her owner, she is frequently confined to a coop, called in Surrey a *rip*, for some weeks after the chicks have seen the light. Her offspring during this time pass freely through the prison bars, returning at her call, or on occasions of alarm, to the maternal wings, and then hopping out again, to the inexpressible misery of their imprisoned mother, who is kept in this state of confinement until she becomes indifferent to the chickens and disposed to lay again.

The courage of the hen in defence of her offspring has been a common theme of admiration; the force of her maternal solicitude effects the most surprising change in her disposition and temper. Before she attained her matronly character, she was greedy, and always searching for food, fond of gadding about, and timid in the extreme. Now she becomes generous, self-denying, and intrepid; she assumes the fiery temper of the cock, and becomes a virago in defence of her helpless brood. An anecdote is told by White, in his ‘Natural History of Selborne,’ of the punishment inflicted by some hens upon a hawk which had at different times killed their chickens. By some means this hawk was caught, and the owner gave him up to the tender mercies of the bereaved mothers. In his own words, “Resentment suggested the laws of retaliation. He clipped the hawk's wings, cut off his talons, and fixing a cork on his bill, threw him down among the brood hens. Imagination cannot paint the scene that ensued; the expressions that fear, rage, and revenge inspired were new, or at least such as had been unnoticed before. The exasperated matrons upbraided, they execrated, they insulted, they triumphed. In a word, they never desisted from buffeting their adversary till they had torn him in a hundred pieces.”

The same writer calls attention to the language of the fowl, from a pleased twittering to a scream. A laying pullet utters a complacent soft note, but when she has been delivered of an egg, her cackle of delight and importance is loud enough to excite the sympathetic voices of all her companions; when her chickens are hatched, she has a different language, which is intelligible to her little ones. The crested cock has various notes; his tone and language, for such it is in effect, as he calls his favourites to partake of the food which he gallantly scrapes for them, is of a very peculiar kind, and very different from his ordinary voice that is so familiar to us.

Poultry are the better for high feeding from the very shell, and on this account the heaviest corn is often far cheaper for them in the end than tailings, as regards the flesh, or the size and substantial goodness of the eggs. Young chickens may be put up for feeding as soon as the hen has ceased to regard them, and before they lose their first good condition. When chickens are wanted for domestic purposes, they are often left at liberty in the farm-yard, and if they have plenty of good food, they will be in the most healthful state for the table, and rich and juicy in flavour. Mr. Moubray ascertained that pullets hatched in March, if constantly high fed, laid eggs abundantly in the autumn; and if killed in the February or March following, were so excessively fat from the run of the yard as to open more like Michaelmas geese than chickens. Experienced poulterers will fatten fowls in two or three weeks with the aid of grease, which gives a luscious, but, in our judgment, a very disagreeable flavour to the flesh, which, though not actually diseased, is very inferior to that of the fowl fed at large in the common way at the barn-door.

The practice of cramming poultry by the hand is quite common. A machine for this purpose is used in France, by which one man can cram fifty birds in half an hour. It is somewhat on the principle of a forcing-pump. The throats of the birds are held open by the operator until they are gorged through a pipe, which conveys the food from a reservoir below placed on a stool. In fifteen days, fowls are said to attain the highest state of fatness and flavour by this feeding. In addition to the ordinary paste of barley-meal, or meal made into little balls with milk, the dried seeds and leaves of nettles have been recommended by the continental poulterers, some of whom give a little henbane-seed to induce sleep, while others put out the eyes of the prisoners as the most effectual way of keeping them in a state of darkness, which is considered essential to their becoming rapidly fat; and under the pretext of relieving them from the irritation of vermin, they pluck the feathers from their heads, bellies, and wings. While fowls are thus preparing for the knife, though their bodies are closely confined, their hinder parts are free for evacuation and cleanliness, and their heads are at liberty to take in fresh supplies of nutriment.

The practice of making capons (emasculating the males) is practised a little in some of the English counties, and very much in France, where the females are also rendered incapable of breeding, and termed in their unsexed condition *poulardes*, in order to give them the tendency to fatten. An incision is made near the parts, and through this the finger is introduced to take hold of and bring away the genitals, but so carefully as not to injure the intestines: the wound is then stitched up and rubbed with oil or grease; and the comb (which appears to be an unnecessary and gratuitous pain and insult to the sufferer) is often cut off. The females are treated much in the same way, when they do not promise well for laying, or when they have ceased to be fertile; they are deprived of the ovarium. The subsequent treatment is similar to that in the former case. Care is taken to give them good food for three or four days, and during that time to keep them in a place of moderate temperature, to avoid the danger of gangrene, which, considering the time of the year—midsummer, when the operation is usually performed—is a very probable consequence. Pullets of the largest breed are selected for the purpose, as they yield the greatest weight to the poulterer; and if employed in hatching, cover the greatest number of eggs.

Cuvier states that the capon may be taught to hatch eggs and to act the part of a good nurse, with a little bell round his neck to supply the want of a good voice. He asserts that the natural courage and energy of this bird are not abated by the alteration of his condition, in which his audacity enables him to impose on the cocks and hens, so that they allow him to strut about with his former gait of consequential importance and to fulfil his duties without interference or molestation. This seems incredible, as a bold and haughty spirit under such circumstances is unnatural in the extreme. The pallidness of his head and the diminutiveness of his comb and gills indicate the contrary disposition, and he is so despised by the other fowls that they will hardly condescend to roost with him.

Mr. Young, in his 'Report of the County of Sussex,' says that much art and attention are requisite to make capons, and that the Sussex breed are too long in the body for success in the operation, by which many are lost. A perfectly fat capon will weigh from seven to ten pounds.

As soon as fowls are rendered sufficiently fat, they should be killed, or they will lose flesh and become unhealthy. The most humane and expeditious mode of putting them to death is by a smart blow with a blunt-edged stick, such as a child's bat, at the back of the neck. Higglers break the vertebræ of the neck by a sudden twist, and never bleed fowls, as this mode of dispatching them dries up the juices of the flesh. They bleed turkeys and geese however, after a stunning blow in the neck, not by cutting the throat, but by an incision in the upper part of the mouth.

Store fowls will feed well upon the tailings of corn, potatoes, and insects, and require little attention except when laying, during which time the food for the hens should be abundant, and their roosting-places dry and warm.

The diseases of all poultry principally arise from cold and moisture. Rheumatism decidedly arises from this cause. During or after moulting in a wet season, fowls frequently become diseased, as is evident from their drooping appearance, swelled and watery eyes, and the dropsical affections of the legs. Severe laying also sometimes causes emaciation and illness, which give way to a more healthy condition after the moulting season, if they have good food and dry weather.

Chickens are very subject, in wet or variable weather, to a disease called the chip, which appears in about a fortnight after their birth, when they are changing their feathers. Warmth and sunshine are the only restoratives within our knowledge.

The roup is properly an imposthume upon the rump, which is cured or relieved by opening, squeezing, and bathing with warm water. Mr. Moubray, however, who is a good practical authority, states that the roup is a general term for all diseases, though it is chiefly applied to catarrh, which is indicated by watery eyes and running at the nostrils. This last disease resembles glanders in horses, and is infectious, and generally fatal. As all these diseases originate in moisture, dryness and warmth are the best counteracting influences. The nostrils should be washed with soap and water, and the eyes with milk and water. Mr. Moubray recommends a pepper-corn in dough at first to impart warmth, and afterwards calomel three times a week as a finish to the cure.

We have had the trachea of a chicken dying of the gapes (which is the incipient stage of roup) cut and opened, and have taken out narrow worms, about half an inch in length, which lay imbedded in a serous fluid. A medical gentleman, now in the county of Kent, has frequently cured fowls of the same disease by putting the upper part of a feather, stripped for the purpose, down the trachea, turning it round, and thus bringing up the worm, which he thinks is the sole cause of the disease. It may however be the effect of the malady, as is the opinion of many.

The pip, which the same individual considers analogous to the thrush in the human kind (and which is probably a modification of roup), he cures, not by scraping roughly, but by an application of powdered borax dissolved in tincture of myrrh and water, and rubbed on the tongue with a camel-hair brush two or three times a day. This at the same time assists the bowels. The flux is not uncommon. Solid corn is the most certain remedy for this disease. Taken at the commencement, it is rarely serious, but if once established in the constitution, it becomes incurable, and, according to some, contagious. For constipation, bran or pollard, with milk, beet leaves, and lettuces, afford a certain cure.

Much of the foregoing matter applies to the rearing and management of all poultry. The succeeding observations will be brief.

*Turkeys.** — The greatest weight to which our domesticated poultry can be made to attain is 30 lbs., and a turkey of even half this weight is "a dainty dish."

"The varied plumage of the bird in the domesticated state is well known to every one; and in no species is that sure mark of subjection to man more strongly seen. Every gradation of colour, from its original bronze, passing into buff, and in many instances into pure white, may be observed in these strutting denizens of our farmyards." (*New Monthly Magazine*, 'Recreations in Natural History.') The bronze or copper-coloured is not considered hardy, nor often reared, and the varieties may be stated to be only twofold, the dark-coloured and the light.

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* For a most lively and interesting account of this bird, we would refer the reader to 'Ornithological Biography,' by an American, London, 1831.

The dark-coloured birds are most prized for size and hardihood. Notwithstanding the great price which may be obtained for turkeys in London when fat, the finest young birds may be purchased in Ireland, fit for cramming, in September and October, from 4*s*. to 5*s*. a couple, and the light-coloured and smaller ones frequently from 2*s*. 6*d*. to 3*s*. 6*d*. a couple.

Turkeys, though extremely delicate in their infancy, become very hardy, and, if permitted, will roost on the highest trees, in the cold dry nights of winter, without suffering injury The hen, which lays many eggs early in spring, sits thirty days, and covers from twelve to fifteen eggs. It is unnecessary for the turkey cock, as is the case with gallinaceous fowl, to be in constant intercourse with the hen during her period of laying. Two visits from him in that season are sufficient to impregnate all the eggs. She is a very steady sitter, and must be removed to her food and supplied with water, for she would never leave her nest. She wants the alertness and courage and sagacity of the common hen, and might be called a fool with much more propriety than the goose, which is an intelligent bird. The turkey hen is incapable of teaching her young ones how to pick up their food, on which account a poultry-maid should always attend them until they are reared.

"The author of 'Tabella Cibaria' proves it upon the bird that it is 'so stupid or timorous, that if you balance a bit of straw on his head, or draw a line of chalk on the ground from his beak, he fancies himself loaded, or so bound that he will remain in the same position till hunger forces him to move. We made the experiment.' We never did; but we doubt it not, though we cannot accept it as a proof of stupidity. How much wit may be necessary to balance a straw may be doubtful; but gallant chanticleer has never been charged either with fear or folly, and yet you have only to take him from his perch, place him on the table by candle-light, hold his beak down to the table, and draw a line with chalk from it, so as to catch his eye, and there the bird will remain spell-bound, till a bystander, rubbing out the line, or diverting his attention from it, breaks the charm. Many a fowl have we fascinated in our boyish days."*

On account of the constitutional delicacy of this bird, the hatching should not be commenced too early in the spring, and when the chicks are hatched they should be guarded from the extremes of heat and cold for some weeks. Rain is almost always fatal to them in their early stage. Curd, boiled eggs, and barley or oatmeal, kneaded with milk (or water, in case milk should produce looseness), potatoes, nettles, parsley, Swedish turnips, with chopped beet-leaves, after a little time, is their proper food. As they retain so much of their original wild nature as to stray a considerable distance, if permitted, the hen should be tied or cooped for at least six weeks, when the chicks will be hardy enough to follow her about, under the vigilant eye however of the poultry-maid, who should beware of their being caught by a shower.

They are soon familiarised to the society of fowls in the poultry or farm-yard. Without the advantage of the latter, it is an unprofitable speculation to rear any description of poultry on a large scale; but where a farmer's yard presents facilities, the economy of having all those kinds to which the soil and climate are suitable, is considerable. The only caution with regard to turkeys, where gallinaceous birds are numerous, is to have separate houses for them at night. These should be very lofty and well ventilated. They may be altogether open to the air in front, the doors being of trellis-work. Fowls (which are equally unsocial with the capons of their own kind) have a strong disinclination to roost with them.

When well grown, turkeys supply themselves in their ramblings so far as to require food only when leaving their house in the morning and returning at night. The chances of rearing a second brood are not so great as to render it expedient to make the trial.

After six months turkeys may be

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* Ibid.

crammed like fowls, but they require a much longer period to render them fully fat. Those great birds which are sent to the London market about Christmas, principally from Norfolk, frequently weighing from twenty to twenty-five pounds, are usually cocks from the preceding year.

Great numbers of turkeys are reared in Ireland, where the climate is congenial to their nature, and no doubt the housewives of that country will improve in the art of fattening them, from the facilities with which poultry may now be brought to the great English markets.

Guinea Fowl.—This bird, which is not much larger than the common barn-door fowl, is of beautiful form and plumage, and though not a source of profit to the peasant who rears poultry for immediate sale, is usually kept where there is proper accommodation, as much on account of the excellence and abundance of the eggs (which, though small, are well-flavoured) as for the sake of the flesh, which is prized in the London markets when the season of pheasant-eating ceases. The number of hens allowed to the male is about the same as among the gallinaceous family. The cock, little distinguished in appearance from the female, is an attentive and affectionate mate, and even obtrusively so to his favourites, whom he will attend to the nest, and remain with until they have laid their eggs.

Retaining some of their original wildness, Guinea fowl dislike the confinement of a house. For the purpose of laying, they prefer shrubberies, clover-meadows, or corn-fields, in which they will deposit their eggs, unless closely watched. The Guinea hen is fruitful during the entire summer, but not earlier than May. On this account and the difficulty of rearing a late brood, it is more beneficial to keep her entirely for laying, and to put the earlier eggs under a common hen or capon, which will cover from twenty to twenty-five, than to encourage the incubation of the natural parent, which is moreover indisposed to it, especially if under cover. If left to her instinct, this bird would at a late season, in the open air, sit for the natural period, which is twenty-eight or twenty-nine days.

The cock, having the same dislike to incubation which characterises the male of pea-fowl, will destroy the eggs if he can discover them. Though the shell is remarkably hard, the chicks break through it at the proper moment, and are soon after as vigorous and ready to eat as the young of any other tribe of poultry.

The loud cry of these birds is not agreeable, but, like the scream of the pea-fowl, it announces with certainty an approaching change of weather. The hen utters a cry when she desires to roost, to call in her companions, to summon assistance, or to give notice of any of those alarms which her sensibilities cause her to express with such energy of voice, and in all which cases she is sure of receiving a ready sympathy.

The same food which is suited to the young of gallinaceous fowls and turkeys is good for the chicks of this kind; but as they are not often destined to the coops for fattening, a good deal of garden or field green-food may be combined with their grits, &c. after the first month. They have a great relish for insects of every kind, and thrive upon them as well as upon hemp-seed. When designed for the table, they ought to be killed at an early age, at which time the flesh is more juicy than that of other poultry of the same age, and very like that of the pheasant, though when old it becomes exceedingly tough.

Ducks.—The white duck, being the largest of the common domesticated kinds, is perhaps the best for the poulterer, though it is not deemed so delicate in flavour as the dark-coloured, such as that bred from intermixture with the Rhone duck, which is also large. The Muscovy variety is said to be a good breeder. One drake is sufficient for five females. It is generally believed that the duck lays no more eggs than she can cover (from twelve to fifteen), but Mr. Moubray states that, if well fed, some ducks will lay a great number, and he gives an instance of one laying an egg every day for eighty-five days.

For a fortnight after their birth ducklings should be kept from rushing into water, to which their instinct soon leads them; and with this view the mother is frequently confined (where there is any pond within her reach) to the rip, already described, which should be placed on a field of short grass with a flat dish of water near it. The ducklings waddle about in search of insects, and at the maternal call return to the coop. This restraint upon the liberty of the poor mother should be avoided if circumstances permit, for to protract her close confinement after more than four weeks' sitting is a cruel restraint. It is very common to place duck-eggs under a hen, on account of her excellent qualities as a nurse.

Any kind of meal is good for ducklings at first, and this may soon be mixed with potatoes. The refuse of the kitchen will not only support but fatten them; but to have them quickly and highly fattened, they should have oatmeal made into paste. They will also devour any animal offal, and have no fastidiousness whatever. If allowed to follow a plough or attend on the gardener when his spade is at work, their greediness and activity in picking up worms are extreme; and for gobbling up snails and slugs and other such delicacies in the field or garden they are most useful, while they are at the same time putting themselves into high condition. Having no fastidiousness of appetite, they never require cramming, indeed they act as if they considered it their duty to get fat as quickly as possible, and therefore required no artificial aid.

In a poultry-yard the ducks and geese are frequently lodged on the lower floor of the fowl-houses, but it is better, if the locality will permit, to give them distinct chambers, particularly where a good pond (free from eels) is available; on the margin of this their huts may be placed with very trifling labour, and an invisible paling* all round the water, constructed at bottom on the principle of the cage-trap, so as to prevent the ingress of rats or weasels, while it affords them a ready outlet, renders this department of the poultry establishment complete, though far too expensive for common adoption.

"Many families in Bucks derive a comfortable living from breeding and rearing ducks, the greater part of which, the early ones at all events, are actually brought up by hand. The interior of the cottages of those who follow the occupation presents a very curious appearance to the stranger, being furnished with boxes, pens, &c., arranged round the walls for the protection of the tender charge of the good wife, whose whole time and attention are taken up with this branch of domestic economy.*"

Geese.—The proportion of females to the males is the same as in the duck tribe, and the period of incubation and the number of eggs that may be set correspond exactly. The goose lays in a mild spring very early, and on this account (but only with high corn-feeding in the previous winter, and stimulating food during the entire breeding season) two broods may be had in the same year. Unlike the peacock and the Guinea cock, the gander is not only indisposed to do any mischief to the nests, but is very attentive to the hatching birds, whom he vigilantly protects as he sits patiently by; nor is his protection, as he accompanies the goslings in due course, less creditable to his paternal character. The goose is a very steady sitter, but usually rises often enough to drink and take sustenance, without its being necessary to remove her from her nest for the purpose.

The early treatment of the goslings is similar to that of ducklings. The mother should be penned up for some days upon dry grass, but neither too early nor very late in the day; beet leaves or other green food may be mixed even with the early diet, if immediate fattening be not the object.

Green geese are brought very early to the London market, and are worth at first from 8*s.* to 12*s.* each: they can be made quite fat with oat-meal and peas, and skimmed milk or butter-milk, when from four to six months old: many prefer oats alone.

The management of them in the vicinity of London is thus detailed in a communication to Mr. Moubray:—

"Cleanliness, punctuality, and regularity prevail; the business is conducted, as it were, by machinery, rivalling the vibrations of the pendulum in uniformity of movement. The grand object of preparing, not geese only, but poultry in general, for market, in as short a time as possible, is effected solely by paying unremitting attention to their wants; in keeping them thoroughly clean; in supplying them with proper food (dry, soft, and green), water, exercise ground, &c. On arriving at the feeders, they are classed according to condition, &c.: they soon become reconciled to their new abode and to each other. They are fed three times a day; and it is truly astonishing how soon they acquire the knowledge of the precise time; marching from the exercise ground to the pens like soldiers in close column. Goslings, or young geese, come to hand generally about the month of March, after which a regular and constant supply arrives weekly throughout the season. At first they are fed on soft meat, consisting of prime barley or oat meal, afterwards on dry corn. An idea prevails with many that any sort of corn will do for poultry: this is a grand mistake. Those who feed largely know better, and invariably make it a rule to buy the best. The Messrs. Boyce of Stratford, whose pens are capable of holding the extraordinary number of four thousand geese, independent of ducks, turkeys, &c., consume twenty coombs of oats daily, exclusive of other food."

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* Such may be seen at the Zoological Garden in the Regent's Park, London.

* Moubray.

But though green geese bring an enormous price in the spring, if thoroughly fat, farmers generally find it more profitable to feed goslings on the stubbles, where they supply themselves with the best food without cost, and become sufficiently fat at Michaelmas, when ancient custom renders them a favourite dish.

At Michaelmas, by right divine,
Geese are ordain'd to bleed at Michael's shrine.

In the neighbourhood of the extensive commons in England great numbers of geese are kept.

Nought is useless made; on the barren heath
The shepherd tends his flock, that daily crop
Their verdant dinner from the mossy turf
Sufficient; after them the cackling goose,
Close grazer, finds wherewith to ease her want.
Phillips's 'Cyder.'

But from the system pursued by the monopolising farmers of turning large flocks of sheep to consume the growing blade, the poor geese have short commons indeed, and gain little except air and exercise by their ramblings. The cottagers however supply them with the refuse of their gardens, and the goslings, when the harvest comes in, are brought up by the farmers, and fattened on their stubbles.

Though young geese are subject to a disease called the cramp, the greater number of those which die in summer are destroyed by starvation, and the change from corn, and other nutritive food, to the miserable herbage which the fields and commons yield; and this constitutes their chief diet until the harvest season. Cold and wet weather are often fatal to them in the earlier months, if they be neglected. Much mortality also prevails amongst grown geese, wherever the horrible system of plucking them alive prevails, as in Lincolnshire and in Ireland.* It is generally urged in excuse for this barbarity, that feathers are most elastic and valuable before the period of moulting, and that geese have been thus treated ever since feather-beds came into fashion. The offence carries some punishment with it; for it renders the flesh very tough, and in many respects deteriorates the value of a bird, if it does not destroy it altogether; but the immediate gain from the feathers counterbalances this and every humane consideration.

The cramming system is practised in France, when the object is to render the liver unnaturally enlarged by disease, with circumstances of great cruelty. We do not intend to give any information upon practices which we cannot recommend, and which we strongly condemn.

Eggs.—The most certain way of preserving eggs fresh is by greasing them with some unctuous matter, or immersing them in a strong solution of lime. In packing, they should be laid on end; for otherwise the yolks, preserving their centre of gravity, fall to the lowest side, and by adhesion to it become tainted sooner than if they were suspended in the centre.

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* See Doyle's *Cyclopædia of Practical Husbandry*, page 395.

The only management, besides warmth and high feeding, by which a perpetual succession of eggs can be obtained in winter, is by having pullets and hens of different ages, which, moulting at different periods, are not all incapacitated from laying contemporaneously.

RAPE. This plant, which is of the cabbage tribe, is cultivated like cole, or colza, for the sake of its seeds, from which oil is extracted by grinding and pressure. It is also extensively cultivated in England for the succulent food which its thick and fleshy stem and leaves supply to sheep when other fodder is scarce.

The mode of cultivation of the colza and rape for seed is nearly the same. The colza takes a longer time to come to maturity, and produces more seed. The rape grows on less fertile soils, and may be sown in spring as well as in autumn. Both are hardy, and resist the winter's frost.

The colza (Brassica oleracea or campestris) is a plant which grows with a strong branching stem, three or four feet high, and requires room to spread; the plants are therefore raised in a seed-bed, and transplanted when they have acquired a certain size. When rape (Brassica napus) is cultivated for the seed, it is treated in the same manner; one description will therefore serve for both.

The seed-bed, where the cultivation is on a small scale, is usually prepared by digging or trenching with the spade, in a good loamy soil, neither too sandy nor too wet. A large proportion of rotten dung is spread evenly over it, and dug in six inches deep, and the surface is raked fine. The seed is sown broad-cast or in drill; the latter is the best method: it is then slightly covered with the rake; and if the ground will allow of it, without risk of its being bound too hard in case of dry weather, it is well rolled or trod with the feet. The seed must not be sown too thick; and the plants, as soon as they have six leaves, must be thinned to a distance of four or five inches in the rows, which will make them stronger and better furnished with roots. One acre of seed-bed will furnish plants for ten acres or more. The seed is sown in July or August, that the plants may not run to seed the same year, which they are apt to do if sown early; and they are transplanted in September or October, on land which has already borne a profitable crop. As this crop is a substitute for a fallow on rich heavy land, too much pains cannot be taken to keep it free from weeds. Winter barley, and rye, which are reaped early in July, are very proper crops to be succeeded by rape or colza. The stubble should be ploughed two or three times, to pulverise and clean it. A good coat of rotten dung should be put on, and the land ploughed in ridges, as for turnips: the plants should be put in on the ridges ten inches apart. It requires great care in taking them up not to break the fibres of the roots; they should be raised with a fork, and placed gently, with the fine earth adhering to them, in flat baskets, and in a slanting position, so that the tops may be upwards. In planting, the holes should be made with a large thick dibble, that the plants may be introduced without doubling up the principal roots or breaking the fibres. The earth should be pressed to the root by a short dibble, inserted to the right or left of the hole made by the first dibble; or, which is better in stiff soils, a hole should be made with a narrow hoe of sufficient depth to allow the plant to be placed in it, and another hoe should follow to draw the earth to the plant. Thus two men with hoes, and one woman, will plant a row more rapidly than could be done in any other way: the man who fills up the holes places his foot by the side of each plant as he goes on, to press the earth to the roots.

An expeditious mode of planting rape is used in Flanders. A spade ten inches wide is pushed vertically into the ground, and, by drawing the handle towards his body, the labourer makes a wedge-like opening; a woman inserts a plant in each side of this opening, and when the man removes the spade, the earth falls back against the plants. The woman puts her foot between the two plants, and they are then fixed in their places. In this operation the man moves backwards; and the woman, who puts in the plants, forward.

Instead of the spade, an instrument is also used called a *plantoir*. It consists of two sharp-pointed stakes a foot or more apart, connected by a cross-handle at top, and a bar at about eight or ten inches from the points. The instrument is pressed into the ground by the handles, assisted by the foot placed on the lower bar, and makes two holes, a foot apart, into which the plants are placed, and earthed round as before. This is done when the land has not been laid up into high ridges.

When a large field is to be planted, a more expeditious mode is adopted; and this is the most usual practice in Holland and Germany. The land having been prepared, and the manure well incorporated, a deep furrow is drawn with the plough; women follow with baskets of plants, which they set, a foot apart, slanting against the furrow slice. When the plough returns, the earth is thrown against these plants; and a man or woman follows, who, with the foot, presses the earth down upon the roots. Sometimes plants are put into each furrow, which is then ten inches or more wide; but the best cultivators put them only in every alternate furrow. In this case also there are no ridges. The season of the year affords sufficient moisture in the north of Europe to ensure the growth of the plants; and if they have escaped the fly in the seed-bed, they are now tolerably safe. No further attention is requisite till spring. The weeds are then carefully extirpated by hand and hoe; and where the distance of the plants admits of it, the light plough stirs the ground between the rows, throwing the earth towards the stems; yet so as to leave each plant in a little basin to catch the water and conduct it to the roots. When the plants are invigorated with rich liquid manure, such as night-soil mixed with water, or the drainings from dunghills, they become extremely luxuriant; and every trouble or expense bestowed upon them is amply repaid. The difference between a crop partially neglected and another carefully cultivated often exceeds fifty per cent.

A moderate return of seed for colza is thirty bushels per acre, but it frequently exceeds fifty. The value on the Continent is nearly the same as that of wheat. In England it is somewhat less, owing to the quantity imported. It is usually sold by the last of ten quarters.

There is not much difference between the value of colza and rape-seed (called *navette* in French): but the latter produces less. When the rape is transplanted before winter, it is much more productive than when sown in spring. In the latter case it produces seed the same year. It is sown in drills, and thinned out by the hoe, and in favourable seasons a tolerable crop is obtained. It is generally sown on land which could not be brought into a proper tilth after harvest, and which would require the frost of winter to mellow it.

Great crops of cole-seed and rape have been produced in the fens of Lincolnshire and the alluvial soils in Essex, by merely paring and burning the surface and ploughing in the ashes; and these crops, alternating with oats, have in many instances so exhausted the soil as to cause a great prejudice against them in the minds of the landlords. Many leases have a clause prohibiting its cultivation, except to be eaten green by sheep. The principal cause, however, of the diminution of this crop in England is the inferior price obtained for the seed when compared with wheat, which can be raised on the same land, and is a more certain crop.

The rape and colza ripen their seed very unequally. The lower pods are ready to burst before those at the top are full. If the season is wet at harvest, much of the seed is lost; and, without great attention, some loss is sustained in the most favourable seasons. It should be cut when the dew is on it, and moved as little as possible. If the weather permits, it is thrashed out on a cloth in the field, and as many thrashers are employed as can be conveniently collected, that no time may be lost, when the weather is fair. The seed is spread out on the floor of a granary, that it may not heat, and is turned over frequently. It is then sold to the crushers, who express the oil. The pods and small branches which are broken off in thrashing are much relished by cattle.

This crop returns little to the land, and is of itself very exhausting. Not so, however, is the rape, when sown as food for sheep. It is, on the contrary, a valuable substitute for turnips, upon land which is too wet and heavy for this root. The Brassica oleracea is more succulent than the Brassica napus. Its stem is not so hard, and the soft pith which it contains is much relished by every kind of live-stock. To have it in perfection, the land should be prepared and manured as for turnips. The rape should be sown in drills ten inches apart, about the beginning or middle of August, which gives ample time for preparing the land, without interfering with the turnip crop. It will be sufficiently forward before winter, and it should then be hoed over once. If the crop is very forward, it may be slightly fed off: but, in general, it is best to let it remain untouched till spring. In the end of March and the beginning of April it will be a great help to the ewes and lambs. It will produce excellent food till it begins to be in flower, when it should immediately be ploughed up. The ground will be found greatly recruited by this crop, which has taken nothing from it and has added much by the dung and urine of the sheep. Whatever be the succeeding crop, it cannot fail to be productive; and if the land is not clean, the farmer must have neglected the double opportunity of destroying weeds in the preceding summer and in the early part of spring. If the rape is fed off in time, it may be succeeded by barley or oats with clover or grass seeds, or potatoes, if the soil is not too wet. Thus, no crop will be lost, and the rape will have been a clear addition to the produce of the land. Any crop which is taken off the land in a green state, especially if it be fed off with sheep, may be repeated, without risk of failure, provided the land be properly tilled; but where cole or rape have produced seed, they cannot be profitably sown in less than five or six years after on the same land.

When the oil has been pressed out from the seed, the residue (which contains a portion of starch and mucilage not changed into oil) and the husk of the seed form a hard cake known by the name of rape-cake. This is used on the Continent to feed cows and pigs with, as we use the linseed cakes: but it is also much used as a rich manure, and for this purpose it is imported in large quantities. When rape-cake is ground to a powder and drilled with the seed on poor light lands, it supplies nourishment to the young plants, and greatly accelerates their growth; but if it be added in a large proportion in immediate contact with the seed, on heavy impervious soils, it often undergoes the putrid fermentation, which it communicates to the seed sown, and, instead of nourishing, destroys it. In this case it is useful to mix it with some dry porous earth or with ashes, which will prevent the too rapid decomposition. Dissolved in water and mixed with urine, it forms one of the most efficacious of artificial liquid manures. Hence it is probable that the most advantageous mode of using it on the land, after it has been dissolved in the urine-tank, is to apply it by means of a water-cart to the rows where the seed has been already drilled, or some time before it is put in. Where flax is to be sown, this mixture applied a few days before the seed is sown, so as to allow it to sink into the soil, is considered in Flanders as next in value to the emptyings of privies, which with them hold the first rank, for producing fine crops of flax. When a crop appears sickly, and not growing as it should do, owing to poverty in the soil, a top-dressing of rape-cake dissolved in water, if no urine is at hand, will generally excite the powers of vegetation; and it is highly probable that it may greatly assist the effects of saltpetre or of nitrate of soda, where these salts are applied. The cultivation of rape or cole for spring food cannot be too strongly recommended to the farmers of heavy clay soils.

RAT. Few animals are more destructive of every kind of grain than rats. When a barn is infested with them, it is scarcely possible to get rid of them. They will leave it for a time, and the farmer imagines that they are all destroyed; but no sooner is the corn brought in than they resume their depredations. There are means, however, of destroying them, and some of these means are equally effectual and ingenious. The most obvious way of destroying rats is to poison them, which appears an easy matter; but it is not so without an accurate knowledge of the habits of these creatures. Their sense of smelling is more acute than we can well conceive, and their caution is not easily deceived. It is difficult to entice them with food when they have plenty of grain to satisfy their hunger. Patience and perseverance alone can lull their caution to rest.

The principle on which all rat-catchers proceed is to entice the rats to some particular spot, convenient for their future operations. There are some strong scents which these animals seem to delight in; and, by means of these, their natural sagacity is deceived. Oil of rhodium, of carraway, or aniseed, and musk, are great favourites with rats. Rags impregnated with these, and which have not been in contact with any part of the body of a man, being laid, as if by accident, will induce them to come out of their hiding-places in the night, and frequent the spot where the smell attracts them. Gradually they will become familiarised with the place; and pieces of tallow or cheese or malt-dust may be placed near without exciting their suspicion. After they have been fed for a time, they will readily eat anything that may be thrown down, provided it has not been touched by the hand without the covering of a glove properly scented. It will take some time to accomplish this; and when they are to be poisoned, a quantity of poisoned food, similar to what they have been accustomed to feed on, must be prepared, sufficient to poison all those which are supposed to frequent the place. The poisons commonly used are arsenic, nux vomica, powdered Spanish flies, and cocculus indicus, which intoxicates them, so that they may be taken by the hand. A small chamber, or a large chest or box, is convenient to collect the rats; and in order to induce them to go in, pieces of toasted cheese or red-herring are trailed along the ground from the rat-holes to the place where it is wished that they should assemble. As soon as they have been accustomed to find food which they like, they will all come to it in the night; and they can be poisoned, or caught by some contrivance by which the only entrance to the place or box can be suddenly closed. When traps are set, they should be left open for a time, and the rats allowed to go in and out without hinderance, till they crowd together in them, and can be taken in great numbers. When rats have been caught in a trap, and have soiled it with their excrements, it should not be washed, nor much handled: it should be left in the same spot as long as any rats are caught. Any change of position excites their caution. An ingenious trap is made by stretching a piece of parchment over the open end of a cask, and enticing the rats to eat the food laid upon the parchment. When they have evidently been there to feed, cross cuts, a few inches long, are made in the parchment with a penknife; and in the bottom of the tub, which has four inches of water in it, a brick is set on its edge, so as to rise just out of the water. The rats coming for food, as usual, some one soon slips through the parchment, and, falling into the water, seeks refuge on the brick: as more fall in, they fight for the possession of the brick, and their noise attracts all the rats within hearing. Thus it is said that a great number may be caught in one night. In the 'Cyclopædia of Agriculture,' by Loudon, there is a description of a very complicated trap for rats, which appears very ingenious; but whether it is effective we have not had an opportunity of proving.

REAPING (or cutting the corn when it is ripe) is one of the most important operations of harvest. It requires many hands to accomplish it in proper time, so that the corn which is ready for the sickle may not be too ripe and shed, nor the fair weather be allowed to pass before all the corn is secured in barns or stacks. The labourers who are required all the year for the common purposes of husbandry seldom suffice for the harvest, especially on extensive farms, and recourse is usually had to the assistance of mechanics and artisans from the neighbouring towns and villages where the population is considerable, or labourers are induced by good wages to come from a distance. As the harvest is later in those parts of every country which have a more northern situation, or are higher above the level of the sea, bands of reapers from these come to assist in the harvest of those tracts whose produce is earlier. To encourage the annual return of so desirable assistants, every encouragement is given them, not only by wages, but also by food and drink, and amusements after the toil of the day. Thus the time of harvest is a time of rejoicing both to the labourers and the master.

The common reaping-hook, or sickle, with which the corn is usually cut, is one of the oldest instruments of husbandry; and the goddess Ceres was generally represented by the ancients with a sheaf of corn and sickle in her hand. In reaping with the sickle, a portion of the stems is collected with the left hand, and held fast; while the sickle in the right hand is inserted below the left, taking the stems in its semicircular blade, and cutting them through by drawing the sickle so as to act as a saw, for which purpose the edge is finely serrated in a direction from the point to the handle. The heads of the corn, with the upper part of the straw, are then laid on the ground in quantities which may readily be collected into a sheaf. Practice soon gives dexterity to the reaper; and he finds it more expeditious to cut small quantities in succession until he has filled his hand, than to attempt to cut through a large handful at once. Severe wounds are often inflicted on the fingers of the left hand by beginners, even to the loss of a finger; but this soon makes them cautious and expert. The division of labour is introduced with advantage amongst a band of reapers. A certain number cut the corn, while others follow to gather the sheaves; some only preparing the bands, and others tying them and setting up the sheaves into stooks or shocks, which usually consist of ten or twelve sheaves. The smaller the sheaves are, the less injury the corn sustains in a wet harvest; as the moisture in a thick sheaf does not so readily evaporate. Hence it is the interest of the farmer to see that the reapers do not make the sheaves too large. In many places there is a regular measure for the circumference of a sheaf, which should never exceed thirty inches. The bands are made by taking two small handfuls of the cut corn, and crossing them just below the ears into a knot. The sheaf is then pressed with the knee, and the band drawn tightly around it. The ends are twisted together like a rope, and inserted under the band, which effectually fastens it. This operation is soon learnt, and is done very rapidly. The sheaves should be so tied that there may be no danger of their falling loose when pitched into the cart or stacked, without being so tight as to prevent the moisture in the straw from evaporating. They should not be tied too near the ears, but rather nearer to the butt. The sheaves, when tied, are placed two and two on the butt-ends, with the ears leaning against each other: sometimes they are placed in a circle, all the ears being together, and the butts slanting outwards: a sheaf is then opened, by inserting the hand into the middle of the ears, and reversed over the tops of the preceding, forming a cone, and covering all the other ears, while it hangs down around them. In this position they will bear much rain without injury. It is a good practice to place the shocks across the furrows between the stitches or lands, so as to allow the air to circulate more freely around them. In this case four or five sheaves are placed in a row, leaning against as many in a parallel row; and two sheaves, being opened, are reversed over them to protect the ears. Whatever be the mode adopted in reaping the corn, the same kind of sheaves are formed, and set up in shocks.

Wherever the sickle is used for reaping, the straw is cut at a certain height from the ground, and the remainder forms a long stubble, which is usually mown at leisure after harvest, and carried into the yard for litter; but in the neighbourhood of large towns, where straw is sold at a good price, or exchanged for stable dung, it is important that as much as possible of it should be cut with the corn. This has introduced the practice called fagging, and sometimes bagging, the origin of which provincial expressions is not well known. The instrument used for this purpose partakes of the nature of a scythe, as well as of a reaping-hook. It is shaped like a sickle, but is much larger and broader; and instead of being indented like a saw, it has a sharp edge like a scythe, which is renewed when blunt by means of a stone or bat. The fagging-hook cuts the straw close to the ground by a stroke of the hand; and its curved form is only useful in collecting stray stems, and holding a certain quantity of them between it and the left hand of the reaper when he makes up a sheaf. A certain quantity is cut towards the standing corn, the left hand pressing it down at the same time. When as much is thus cut as would make half a small sheaf, the reaper comes backwards, cutting in a direction at right angles to the first, and rolling together the two parts, which he carries in the bend of his hook and places on the band which had been prepared for him. A full-sized sheaf is usually composed of two cuttings. Two men will fully employ a third to make bands for them, tie up the sheaves, and set them up. This method of reaping is laborious, on account of the stooping required to cut near the ground. The Hainault scythe, which has been described in most agricultural works, does the work better, and with less fatigue: it is in fact a fagging-hook, not quite so curved, of which the handle is longer, and placed at an angle with the plane of the blade. It requires some practice to give the proper swing to it by a peculiar motion of the wrist; but when this is once acquired, a considerable saving of labour and time is effected. Many attempts have been made to bring it into use in England; but from the obstinacy of the labourers, or the want of perseverance in the masters, without much success. A better instrument however on extensive farms is the cradle-scythe, which, in the hands of an expert mower, will do more work and more effectually secure all the straw than any other instrument.

The objection to the great barn-room required for so much straw is obviated by the practice of stacking the corn in the open air on proper stands to keep it dry and out of the reach of vermin. The additional trouble in thrashing is not so great as that of mowing or raking the stubble, which is generally deferred till half of it is lost by decomposition by the air and moisture. The advantage of mowing extensive crops is clearly shown in a paper in the fourth number of the 'Journal of the Royal Agricultural Society of England,' by Mr. Rodwell, of Alderton Hall, Suffolk, who has found by experience that the crop of wheat which was mown by the scythe and tied up in sheaves was fully as soon fit to be carried as that which had been reaped. When the saving of time is considered as well as the saving of expense, there seems to be no doubt that on an extensive farm the scythe is far preferable to the sickle for cutting every kind of grain. Barley and oats are usually mown and carried without tying them into sheaves, but this is a slovenly and wasteful practice: by means of the cradle-scythe they may be mown so regularly as to be readily tied into sheaves; and the additional expense will be fully compensated by the saving of all the corn which, being on the outside of the stack, is lost by the depredations of small birds.

Beans are usually reaped by the sickle, the stems being too strong and too wide apart to admit of the scythe. Where it can be done conveniently, without the soil adhering too much to the roots, it is better to pull them up, and tie them in bundles with straw bands, or tar-twine, which will be found both a convenient and economical method.

Peas are generally reaped by means of two large hooks similar to the fagging-hooks, one of which is held in each hand; and the stems, which are generally much interwoven, are partly cut and partly torn from the roots, and so rolled up into a small bundle laid loose in order that it may dry. Tares are reaped in the same way.

The expense of reaping corn is considerable, especially where the population is scanty. In the eastern counties men are engaged for the whole harvest, which, in favourable weather, is supposed to be completed in a month. During this time they have their usual daily wages, with or without food, and a certain sum besides, as harvest money. In other districts the labourers reap the corn by the acre, with a certain allowance of beer, or money instead of it. The price of fagging in Middlesex, and within 30 miles around London, varies from nine to twelve shillings per acre, according to the crop; and if it is lodged, as much as fifteen shillings is often paid, including beer. The use of the scythe considerably diminishes the expense, as fewer labourers are required.

There have been many attempts to introduce machinery for reaping corn. Some of the inventions were ingenious and promised well, but none, when put to the test, answered the expectations formed. The various inclinations of the straws prevent any regular mode of cutting. The principle of most reaping-machines is that of a revolving edge to cut the straw, and a drum to lay the cut corn down regularly. Wherever the corn is laid or lodged, it is evident that no machine can collect straws lying in every imaginable direction and interwoven with each other. Till some better invention appears, the scythe will probably be found the cheapest and most expeditious instrument for reaping the corn. At the Derby Agricultural Meeting in 1843, there was a very large exhibition of agricultural implements, which included specimens of every article hitherto found useful in agricultural operations, but it did not contain a reaping machine of any description.

ROTATION OF CROPS. It has been observed in a former article [ARABLE LAND] that a repetition of the same crops in succession has a peculiar effect on the soil, so that if grain of the same nature be sown year after year in the same ground, it will not produce the same return of the seed, even when abundantly manured. The reason of this is not satisfactorily explained, but the experiments which have been made by men of science lead us to conclude that the real cause will be gradually discovered; and considerable advances have been made towards a rational solution of the question. It has been observed that it is the formation of the seed which principally causes the deterioration of the soil; for if the crop be fed off in a green state, or mown before the seed is formed, the same may be safely repeated, and no diminution of the plants is apparent. Thus grasses in a meadow which are mown before the blossom is faded or the seed formed, will spring up again vigourously; but if the seed is allowed to ripen, the roots die away, and the best grasses gradually disappear. It is thus that when a meadow is mown year after year for hay, and the earliest grasses are allowed to ripen their seed, the crop will be later and later, and all the earliest grasses will disappear. Irrigation prevents this, and seems to restore to the land whatever the grasses require for their continuance. Feeding off the meadows does the same; and this leads to the conclusion that water restores the power of production; and that, the grasses not being permitted to run to seed, the deteriorating effect is not produced.

If it had been a mere exhaustion of the nutritious particles in the soil which caused the deterioration of the subsequent crops, some kind of manure might restore the fertility; but this is not the case. However judiciously the land may be manured, it is not practicable to raise a crop of wheat or clover, or of many other plants, on a soil which has shown that, as the farmers say, it is *tired* of that crop; but clover grows well after wheat, and wheat after clover, so that the same effect is not produced in the soil by these two crops. Experiments have been made by eminent chemists, particularly by Macaire of Geneva, at the request of De Candolle, which lead one to suppose that, in the formation of the seed or other nutritious parts of plants, the sap is digested, that it takes up certain elements, and deposits others, which are the residue of the process: and these, being no longer necessary to the formation of the seed, are rejected by the vital action of the plant, and exude by the roots. Thus certain inferior animals, which in many respects have some analogy with vegetables in their growth, as the polypi, take in nourishment by the same openings or pores by which the excrements are voided after digestion; and the different constitution of different animals enables one class to feed on the excrements of another; whereas no animal in a healthy state can derive nourishment from that which it has already digested and voided. Our ignorance of the functions of vegetable life prevents us from foreseeing the effects produced on the sap by the expansion of the blossom or the ripening of the seed; but experience leads us to perceive that certain plants thrive best after certain others; and that in this case they are always of distinct and different natures. A plant which has fibrous roots, and throws up a seed-stem with few leaves, thrives best after one which has a fleshy root and many succulent leaves on a branching stem. Thus, wheat thrives after beans, vetches, or clover; barley and oats after turnips, carrots, or potatoes. Independently of the manure which may be put into the ground, the crops will be better where the proper succession is attended to, than where plants of a similar kind are made to follow each other. To ascertain the cause of this, Mr. Macaire and some other scientific men observed the change which took place in the water in which wheat had been made to grow. They found a deposit in the water of the nature of a bitter extract; and this they concluded to be excrementitious. Whether these experiments were conclusive or not, they found that beans grew well in the water in which wheat had deposited this supposed excrement; and, on the other hand, wheat throve in the water in which beans had grown. This confirmed the well-known fact that heavy soils of a rich quality and well manured will bear alternate crops of wheat and beans without the intervention of a fallow for a long series of years, as is practised in some parts of Kent. The effect of fallowing land is explained on the same principle; the excrement is washed out by the rains, or is decomposed by the light and air to which it is exposed by the repeated ploughing. Thus the land is said to be *sweetened*, an expression very common among those farmers who adhere to the fallowing system.

If the chemical nature of the excrement of each plant cultivated could be accurately ascertained, artificial means might be discovered, by which the same effect might be expeditiously produced, which now requires a whole season of fallowing. But experience and observation have anticipated science, as is often the case; and a judicious rotation of crops has been found to prevent the bad effects of the change in the constitution of the soil which is caused by the growth of particular classes of plants; whether it be that they deprive it of peculiar salts, as some will have it, or deposit deleterious particles, according to others. However interesting it may be to the curious inquirer to ascertain the real cause, it is sufficient for the practical farmer to learn by experience what crops succeed best after each other, and how soon the same kind of seed may again be sown in the same ground with a reasonable prospect of its producing a good crop; and this, after all, can only be learned from actual experiment and observation.

In all countries where peculiar attention has been paid to agriculture, the most advantageous succession of crops is generally known; and if any deviation takes place, it is as an exception to the rule, and is not looked upon as a model for imitation, but rather as an experiment of a doubtful result. Certain general principles are commonly admitted as fully established; the chief of these is, that a plant with a naked stem and farinaceous seed should follow one with a branching stem and a fleshy root, which has been taken from the ground by mowing or feeding before the seed was ripe; or if all these conditions cannot be obtained, that some of them at least should be complied with. Wheat sown after clover, which is allowed to be the best succession on light soils, fulfils all the conditions: when it is sown after beans, the condition of the preceding crop not ripening its seed is given up; and consequently this succession is inferior to the other. Potatoes, at first sight, appear to fulfil all the necessary conditions; but although they do not often ripen the seed above ground, the bulbs of the roots contain so much farina, that in the formation of these the soil is notoriously deteriorated; and farmers well know that, except in peculiar cases which form exceptions, wheat never thrives so well after potatoes as it does after clover, even when the ground has been so richly manured as to contain more organic matter in a soluble state than there is in the roots of the clover.

A knowledge of the different plants which may succeed each other on the same land is of great importance in forming a judicious rotation, so as to obtain the most valuable produce from any given soil, in as quick recurrence as possible without the risk of failure. In the triennial system, which could only be profitable where much of the land remained in a state of pasture, two crops of corn were taken in succession after a complete fallow. But even here it was found advisable to have different kinds of grain, and not to repeat the same crop without a fallow intervening. In very rich soils wheat and barley were the usual crops after the fallow; and the manure was obtained by means of cattle or sheep kept on the pastures in summer and on hay and straw in winter. Repeated ploughings were indispensable; and the farmer who stirred his land the most was the most certain of good crops. But when pastures were broken up, this system soon exhausted the soil for want of manure, and it became indispensable to devote some portion of the land to raise food for the animals whose dung is required to keep up the fertility. Hence the introduction of roots and artificial grasses. It was soon observed that the crops of corn were much better on the land which had borne these roots and grasses, even with less manure, than after crops of grain; and a rotation was adopted in which green crops were raised between every two crops of corn. In process of time the fallows were found to be superfluous wherever green crops could be raised with advantage; and the land was kept clean by careful weeding and hoeing. The effect of a judicious rotation on the produce raised in a given time was so evidently advantageous, that it gave rise to a notion that in this alone consisted the whole art of the farmer, even to the neglect of manure; and clauses were introduced in leases prescribing the rotation to be strictly adhered to, often with detriment to the land and loss to the tenant, when the circumstances required a deviation from the rule.

In order to find the crops which may advantageously succeed each other in rotation, many circumstances must be taken into consideration. First of all the quality of the soil, and its fitness for particular crops; next the wants of the farmer and his family, and the maintenance of the stock required to produce a sufficient supply of manure. It is unreasonable to expect poor light land to produce wheat and beans, although by high cultivation these crops may be forced. Rye, oats, and roots may give the farmer a better profit, by being raised at a less expense than more valuable crops, which must be forced with manure, and at best are precarious in soils not adapted to their growth. In moderate loams wheat may recur every fourth or fifth year, whereas in very rich compact loams it may recur every third, and even every alternate year. Clover and many artificial grasses do not succeed well if they recur oftener than every sixth year, or with even a longer interval. Rape, flax, and potatoes require a still more distant recurrence on the same ground. All these considerations lead the farmer to the selection of the most advantageous rotation for the soil of his farm; and where the land in a considerable district is nearly of a uniform quality, experience soon establishes a course which no one finds it prudent to deviate from. It happens frequently, however, that a great variety of soils, very different in their nature and fertility, are intermixed; and then, unless the farmer can apply the true principles of rotations, he may greatly err by following the course, which may be very judicious for the prevailing soil of the district, but not at all suited to some of his fields. Here the old advice to a young farmer, to "look over his neighbour's hedge," may not be a prudent one to follow; and even if there were no difference in the nature of the soil, or in the state of fertility in which it is at the moment, a blind adherence to the practice of others will never lead to any improvement: for such improvement can only be effected by some knowledge of the reasons on which any practice is founded. Hence a knowledge of the crops suited to any particular soil, and the order in which these crops should succeed each other, is indispensable to the advantageous cultivation of a farm.

That which forms the food of man is always the principal object in the cultivation; and, excepting rice, which only grows in warm climates, there is no food more universally used than that which is made from wheat. Rye, barley, oats, and pulse are only substitutes where wheat cannot be raised in sufficient quantities. Next to grain comes meat, chiefly beef, mutton, and pork, of which the consumption increases with the wealth of a nation and the advance of its agriculture. Wheat and fat cattle are therefore primary objects with every good farmer; and he who can raise most wheat and fatten most oxen or sheep or pigs will realise the greatest profit.

Many circumstances may indicate a deviation from the course which, as a general rule, is most advantageous. The facility of purchasing manure from neighbouring towns may allow of more frequent crops of corn, and of nutritious roots which require much manure, such as potatoes, and which give no return to the land in the shape of dung. But we must lay down rules for those who are to rely on their own resources to recruit the land with manure, so that it may give the greatest produce without diminishing in fertility; and this can only be done by a judicious feeding of live-stock.

The simple rotation of wheat and beans alternately would be by far the most profitable in rich clay soil, as both these crops always obtain a good price in the market; but if a whole farm were so cropped, nearly all the manure must be purchased; for, after a few crops, the wheat straw and bean halm would not produce half the manure required for the land. Hay and oats must be purchased for the horses required for the tillage, which might not be procured so readily or so cheap as they may be raised on the farm. On very light sands wheat or beans cannot be raised, except by a very expensive mode of cultivation; but rye, oats, peas, buckwheat, and roots for cattle must be substituted. On chalky loams the principal crops are barley and artificial grasses for sheep. In short, no particular rotation can be prescribed without a complete knowledge of the soil, the locality, and every circumstance connected with any particular farm. As the most universal rule, it may be laid down that every alternate crop should be consumed by animals on the farm, and that, as much as possible, the plants which succeed each other should be of different natural botanic families. Experience has generally shown the time that should be allowed to intervene between the recurrence of the same kind of crop, and we have only to form our plans accordingly.

In order to prove that the principles we have here laid down are not formed on mere theory, we have only to show that experience and observation have led to the same practical results, and that those rotations which have stood the test of the longest experience have been gradually brought to a considerable perfection in consequence of the failures which generally followed any great deviation from the true rational course.

Of the old triennial course (fallow, wheat, barley or oats) it must be observed that the two corn-crops so rapidly deteriorate the soil, that a complete year of fallow is required to purify it, and a good manuring to keep the land in heart, and that all the industry of the farmer cannot keep up the fertility of the land without extraneous help, either from the manure made in towns, or in the farm-yard by cattle bred and kept in commons or pasture-grounds. This system, which prevailed so long, cannot be called a rotation; and no real improvement was introduced into agriculture until the notion of its perfection was exploded, and tenants were permitted to deviate from it. The rotations adopted in the place of this old system necessarily partook at first of its main defects. Green crops were introduced of necessity to supply the loss of the commons and pastures, which, as the population increased, were gradually cultivated as arable land: but the two white crops remained in succession, and even now, such is the force of habit and early impression, that one of the most difficult points to be gained with mere practical farmers is to make them have patience when their land is in a good state, and to prevent their sowing a white crop, which is immediately profitable and obtained at little or no expense, instead of a green crop, which will keep the land in heart and improve it for future crops, but which does not figure in the amount of sales. Yet it can be clearly shown, that in most cases the second corn-crop is dearly purchased by the expense required to restore the land to the state in which it was when the seed was sown a second time; manure alone will not do this; fallowing and repeated ploughing can alone effect it: and whether you plough several times before a crop, or are forced to do so after it, there is no difference in the expense of labour, although there may be much in the value of the subsequent crops.

The Norfolk course (turnips, barley, clover, wheat), which is so well known and deservedly in repute for light sands, has only one defect, which is the too frequent recurrence of clover. Rye grass, the usual substitute in sandy soils, unless it be fed off young, is far inferior to clover as a preparation for wheat, and this accords with the theory; for wheat and rye grass are both of the natural family of the *gramineæ*. Tares or vetches are a good substitute in heavy soils, as well as beans, both of which are *leguminosæ*, but not well suited to light sandy soils. Peas are sometimes introduced; but they are apt to encourage weeds, unless the crop be very heavy, and then they exhaust the soil, and leave little vegetable matter behind them in their roots.

In many countries there are other vegetable products, which are required for the food of the inhabitants, or supply the raw materials of manufactures: these must be introduced into the rotations, according to their effect on the soil and the cultivation they require. Indian corn, or maize, and French beans, for their seed are cultivated in more southern climates as field crops. Potatoes are now an essential product in some districts, and one which, after maize, produces the greatest quantity of food for man from a given portion of land. But potatoes require much manure, and cannot profitably be cultivated to a very great extent as a farm produce, nor repeated on the same land, for any length of time, oftener than once in eight or ten years; they should, however, always enter into the rotation in that portion of the land which is to be much worked, cleaned, and manured after a crop of corn. Flax, colsa, hemp, and many other plants are cultivated in various districts. By a little management a great variety of produce may be introduced with some regularity; and, as a specimen, we will give a rotation which is generally adopted in the neighbourhood of Lille in France, and was noticed in the ‘Journal of the Royal Agricultural Society of England,’ vol. i., part iii., page 292.

The quantity of land is 15 *bonniers* (about 60 imperial acres). Each bonnier is divided into 16 cents; each cent is consequently one-fourth of an acre.

In this rotation there are a great many different crops, but the chief is wheat, which occupies 18 acres in 60, and thus recurs nearly every third year on the same ground. It invariably follows clover, flax, colsa, and beans, all plants of different families from the *gramineæ*. After the wheat, various green crops follow, and, excepting a very small portion of winter barley and rye, which are generally cut green for the cattle, all these are likewise of different families from wheat. Then come colsa, beans, and oats, all but the last of different families from the two preceding; and it must be observed that the colsa plants raised to be transplanted are followed by beans, and the turnips and cow-cabbage by oats, while the colsa for seed comes after tares, rye, winter barley, and clover. This rotation is not a theoretical one, but actually and strictly adhered to by all those who are considered good farmers in the district, where it has been the rule for a century and more. It is not the result of physiological theories, but it is most probably the parent of the theory which is now almost

Rotation of Crops for Four Years.

First Year.			Second Year.			Third Year.			Fourth Year.		
Bon.	Cent.		Bon.	Cent.		Bon.	Cent.		Bon.	Cent.	
0	12	Colsa plants	1	8	Oats	1	0	Clover			
0	6	Turnips				0	8	Flax			
0	6	Cow-cabbage									
			1	0	Tares						
			0	8	Rye						
			0	8	Winter barley	2	8	Colsa	4	8	Wheat
			0	8	Clover						
			0	4	Potatoes						
4	8	Wheat	0	2	Beet-root	0	8	Oats			
			0	2	Carrots						
			0	12	Colsa plants				1	0	Clover
			0	6	Turnips	1	8	Oats	0	8	Flax
			0	6	Cow-cabbage						Wheat.
1	0	Clover				4	8	Tares, &c. (as in the second year)	2	8	Colsa
0	8	Flax	4	8	Wheat				0	8	Beans
2	8	Colsa							1	8	Oats
0	8	Beans									
1	8	Oats	1	0	Clover						
			0	8	Flax						
1	0	Rye and tares									
0	8	Rye									
0	8	Winter barley	2	8	Colsa	4	8	Wheat	4	8	Tares, &c. (as in second and third years.)
0	8	Clover									
0	4	Potatoes									
0	2	Beet-root	0	8	Beans						
0	2	Carrots									
15	0		15	0		15	0		15	0	

The tares, rye, winter barley, and clover are mostly cut green for fodder.

universally adopted by all scientific agriculturists.

Mr. Blackie, who may be considered as very good authority in modern British farming, was requested, when in Paris, to recommend a course of cropping or a rotation suited to the northern portion of France. Probably without any knowledge of what was actually the practice in a part of it, he composed a table of crops, which he considered as suited to a very rich soil in a very genial climate; and if we compare this with the foregoing rotation, we shall be surprised to find how nearly they agree in principle. It has been published in the 'Gardener's Magazine,' vol. ii., and republished in a paper by Mr. Towers in the second part of vol. i. of the 'Journal of the Royal Agricultural Society of England,' and as it is an interesting agricultural document, we insert it in the following page.

It will be remarked in perusing this rotation, that the true principles are strictly adhered to:—wheat follows clover, vetches, beans, and potatoes; and after the wheat we have roots and green crops. The only remark which strikes a practical farmer is that ten aeres of wheat are succeeded by potatoes, and these by wheat again. There is very little land in Great Britain which will bear so severe cropping, without much more manure than a farm of 100 acres can afford for a tenth part of it; but this is very easily modified by substituting a green crop for a portion (perhaps one-half) of the potatoes, and letting the potatoes be succeeded by barley or oats instead of wheat. The rotation will then be less scourging, and better adapted to land of moderate fertility, where extraneous manure cannot be depended upon. We give it as an example of the application of the true theory of rotations, and it is remarkable how nearly it accords with that which was result of practice alone, without theory. We have ourselves for many years adopted a rotation without being tied down to any positive rule, which

Mr. Thomas Blackie's scheme of Rotation upon a Farm of 100 *Acres, as proposed to the French Government.*

First Year. Acres.	Second Year. Acres.	Third Year. Acres.	Fourth Year. Acres.	Fifth Year. Acres.	Sixth Year. Acres.	Seventh Year. Acres.
30 Wheat	5 Turnips 5 Cabbages 2½ Field beet 2½ Carrots 10 Potatoes 3 Vetches 2 Beans	10 Oats 5 Barley 15 Wheat	15 Clover 5 Turnips 5 Cabbages 2½ Beet 2½ Carrot	15 Wheat 10 Oats 5 Barley	10 Potatoes 3 Vetches 2 Beans 15 Clover	30 Wheat
15 Clover 5 Turnips 5 Cabbages 2½ Beet 2½ Carrots	15 Wheat 10 Oats 5 Barley	10 Potatoes 3 Vetches 2 Beans 15 Clover	30 Wheat	5 Turnips 5 Cabbages 2½ Beet 2½ Carrot 10 Potatoes 3 Vetches 2 Beans	10 Oats 5 Barley 15 Wheat	15 Clover
10 Oats 5 Barley	15 Clover	15 Wheat	10 Potatoes 3 Vetches 2 Beans	15 Wheat	5 Turnips 5 Cabbages 2½ Beet 2½ Carrots	10 Oats 5 Barley
10 Potatoes 3 Vetches 2 Beans	15 Wheat	5 Turnips 5 Cabbages 2½ Beet 2½ Carrot.	10 Oats 5 Barley	15 Clover	15 Wheat	5 Turnips 5 Cabbages 2½ Beet 2½ Carrots
10 Lucern	10 Lucern	10 Lucern	10 Lucern	10 Lucern	10 Lucern	10 Lucern *

* To be ploughed up after seven years, and followed by wheat.

has been suggested by circumstances, and in some measure regulated by our conviction of the truth of the theory we have attempted to elucidate. In a clayey loam on an impervious subsoil, but mostly completely drained, we have had turnips and Swedes on high ridges, tares, mangel-wurzel, potatoes, and a portion of rye to cut up green; succeeded by barley and oats sown with clover, rye-grass, and other biennial grass seeds. These were mown for hay the first year, and sometimes the second also, but generally depastured one year at least; then followed beans, and after these wheat. The green crops were put in after repeated and deep tillage, and with an ample allowance of manure. The whole of the layer was top-dressed with peat or coal ashes in the first year, and what manure could be got or spared was put on the second year before winter, when it was ploughed up. All the corn crops were put in upon one shallow ploughing. We have had no reason to repent of pursuing this course: but we allow that one year only in clover would probably be more profitable. The land is not sufficiently fertile by nature to bear wheat after the first year of clover, instead of feeding or making it into hay. This would bring it to some of the rotations adopted in rich alluvial soils. It is a rule which should never be transgressed, that after every crop reaped there should be a remnant of manure sufficient to ensure a good crop the next year; and that this should always be in the land, and considered as stock in trade or capital invested at good interest. By means of judicious rotations and tillage a much greater quantity of produce may be raised at a certain expense of labour and capital, than by any desultory and experimental mode of cropping. The farmer should find it his own interest to cultivate his land according to the most approved principles, and the landlord should impose only such restrictions as will prevent the tenant from injuring himself by diminishing the produce of his farm.

RUSHES are well-known plants which appear in all soils, especially those which are fertile, when the water which cannot be evaporated remains in a stagnant state under the surface. They are most common in moist meadows with a retentive subsoil; and as they not only occupy a space which might produce good herbage, but also greatly deteriorate the hay with which they are mixed, every means to destroy them are employed by industrious farmers. Formerly in this, as in most other instances of defect in the soil, only a temporary remedy was generally thought of. The rushes were mown down at particular times of the year, alkaline ashes and salt were spread over them, and, in some cases, they were destroyed by pouring boiling water on the roots. But all these only killed the individual rushes, without removing the immediate cause of them, or correcting the stagnation of water which invariably reproduced them. The only effectual cure for rushy grounds is a complete system of draining. The truth of this assertion is so generally admitted, that it is unnecessary to dwell upon it. Wherever the land can be effectually under-drained, rushes will generally disappear as by magic. If they are strongly established in the soil, it may take some time before they completely die away, even after drainage, at least in pastures which are not broken up; but if the land is ploughed and has a proper tillage, they will not survive the first year. In rich old meadows, which it would not be prudent to plough up, they may be destroyed by mowing them when they are in bloom, and immediately spreading ashes or salt over the place where they grew. This repeated twice will clear the ground entirely, and the draining will prevent their reappearing.

In heavy grounds which have been laid up in high stitches without thoroughly draining the land, and sown with grass-seeds to remain in pasture two or three years, it is not uncommon to see every interval between the stitches filled with rushes, especially if the land be reduced in fertility by over-cropping. This indicates a wet subsoil, and suggests under-draining; but the rushes are often caused by the very roundness of the stitches, which is supposed to keep the land dry, but which accumulates the water in the water in the furrows. If the land had been laid quite flat, it might have been too wet to produce good crops of wheat, but rushes would not have appeared. In very flat meadows rushes are only found where the land lies very low, with an impervious subsoil, or a want of inclination in the surface to carry off the superfluous water. What might at first sight be considered as an anomaly, is yet perfectly true—no rushes are found in the best water-meadows, although they are for a considerable portion of the year entirely soaked in water; but the water is never never allowed to stagnate for a moment, and is always kept running on and off.

The great advantage which has been obtained by the system of thoroughly draining compact soils, or those which rest on impervious subsoils, has induced the proprietors and farmers of land to employ their capital in this most certain of all improvements, and the consequence will be, that in a few years the question as to the mode of destroying rushes will no longer be heard; and they will only be seen in those low and unprofitable spots from which the water cannot be drawn off by drains, and where they will supply some small resource to the maker of mats and the repairer of rush-bottomed chairs.

RUTLANDSHIRE AGRICULTURE. — The county of Rutland, although the smallest in extent in England, is of some importance in an agricultural point of view. The climate is that of the midland counties of England, and differs in no perceptible degree from that of the surrounding counties of Leicester, Northampton, and Lincoln. Compared with the larger counties, it is altogether a small district, containing only about 90,000 acres of land; but as a proof of the state of the cultivation, it is observed in the ‘Agricultural Report to the Board of Agriculture’ in 1808, that there is little or no waste land in the county. Of the whole surface one-half was then in pastures, only about one-thirtieth in woods, and in the whole county only 30 acres of waste, which probably are long since cultivated in some way or other. Rutlandshire is one of the grazing-counties in which much attention has been paid to rearing choice animals, both oxen and sheep. There are many wealthy proprietors in the county, who more or less encourage agriculture in all its branches. The soil is mostly of a good quality; and the face of the country agreeably diversified, affording good sites for country-seats, parks, and pleasure-grounds: and the richness of some of the natural pastures has no doubt made it, from an early date, the residence of the richer clergy and gentry. The best pastures are on the lias clay, which, with a portion of oolite, red sand, and magnesian limestone, form the principal soils of the county. The pastures are very similar to those of Northamptonshire, and there is no great peculiarity in the cattle and and sheep bred or fed in them. The pure short-horns are the general favourites with those who pay particular attentention to their stock; and the crosses with these are so frequent and repeated, that no other breed can be considered so well established, they having almost entirely superseded the long-horns. There are however other breeds to be frequently met with, bred in other parts of the country, and purchased for the sake of grazing, such as a few North Devon, Hereford, and Scotch oxen. The milch-cows are chiefly short-horns.

There are some low meadows subject to be flooded along the rivers Welland, Guash, and Chater. The first of these having but little fall, the water goes off very slowly from the flat meadows by the side of it; hence the herbage is not of the best quality, and sheep fed there are apt to rot, which they seldom or never are subject to in the upland pastures. Few attempts have been made to produce regularly irrigated water-meadows. It is the opinion of graziers that the good pastures in this county will produce from 40 to 50 stone of meat per acre every year, which gives a return of 6*l.* or 8*l.* per acre gross. The rent consequently may fairly be reckoned worth from 50*s.* to 4*l.* per acre, including poor-rates and tithes. But no such rent is paid for any considerable portion. The farms were formerly of small extent, but they have been increased by joining two or more into one occupation.

The sheep are chiefly of the improved Leicester breed. There are a few flocks of South-downs; but on the richest pastures the Leicester are the most profitable, although the South-down wethers, when moderately fat, produce by far the best mutton. This is the reason why many opulent proprietors prefer them: while the farmers for profit keep the Leicester, which fatten rapidly and at an early age. The improved mode of feeding sheep with turnips cut into long strips by a machine, assisted with corn or oil-cake, is gradually gaining ground on the best farms, and is one of the greatest improvements introduced of late years. The housing, or at least sheltering, the sheep, especially the breeding ewes, in wet and inclement weather, is not yet sufficiently attended to; nor is the saving in food by this means sufficiently appreciated by the farmers. There is however a spirit of improvement abroad which cannot fail to produce rapid advances in all branches of husbandry.

The farm-horses are not of the most active kind, although they are large, and some very strong dray-horses have been bred in the county, and sold to dealers for the London market after having been moderately worked for a year or two. But for general farm-work they are far inferior to the Suffolk or to the active Clydesdale horses. Farmers do not always consider that time is money, and that he who can perform his work in the least time, at the same expense, has more time left for additional work. In harvest, especially, a team which will go with a loaded cart or waggon at the rate of three miles or more in an hour, and trot back empty six miles in the hour, will clear a field twice as soon as those which move little more than two miles in the hour either way.

There being no very considerable dairies in the county, no particular breed of pigs is peculiar to it. The hogs which are fatted are mostly of the Berkshire or Suffolk breed. Some gentlemen and farmers have taken pains to improve their breeds by crosses with the Chinese and Neapolitan; and these two superior breeds have been so frequently used of late years to render the native breeds more prolific and finer in the skin, that very few fine pigs are to be met with without some portion of Chinese or Neapolitan blood in them; and the infusion of a little foreign blood has considerably increased their aptitude to get fat, while some attention to the shape and smallness of the bone has produced a very manifest improvement in general.

The arable land was formerly but indifferently cultivated, as was the case in most parts of the country where grazing was the principal object of the farmer: but by the enclosure of common fields, and the extended cultivation of turnips, of which the value for the cattle in winter is now fully appreciated, a much greater quantity of corn is produced than would, at one time, have been thought possible; and by means of under-draining and an improved husbandry, the land which will produce good crops of turnips, especially the Swedish, is daily increasing.

The plough in general use is one with two unequal wheels attached to the beam, which has of late received the name of the Rutland plough, although it is common to all the adjoining counties. It is often drawn by three horses; but the best farmers begin to use only two, and find that, if the ground be occasionally stirred to a considerable depth by the subsoil plough and heavy scarifiers, with four or even six horses, all the common ploughings, even in the heaviest soils, can be accomplished with a light plough and two horses abreast; and that the work is done better, more rapidly, and at less expense. The course of crops varies according to the nature of the soil; on the lighter soils, turnips, barley, and clover are succeeded by wheat, with an occasional crop of peas. On the heavier, oats and beans are introduced instead of barley or peas, with a naked fallow. The best farmers avoid two white crops in succession; but those who are tempted, by the apparent profit, to have barley after the wheat, and some of the old school cannot resist it, on fine rich soils, find, that what they have apparently gained by a catch crop, as it is called, is dearly paid for in the end, by the deficiency in those which come after, especially the clover and turnips, two crops which never are so sure and so profitable as on land which is in very good heart.

There are several extensive woods in Rutlandshire, containing fine oak, ash, and other timber. The amount of the whole is stated, in the Survey in 1808, at nearly 3000 acres. But they have not improved since that time: the high price of timber during the war has caused many of the finest trees to be cut, and there is now little timber fit for navy purposes in the county; and there being no wastes, the planting has been confined to ornamental plantations. There is a considerable quantity of coppice-wood, which is cut every twelve or sixteen years; and it is the opinion of some very experienced surveyors, that a well managed coppice, with a few trees interspersed, is much more profitable than a close plantation of oaks, however well managed, when the rapid growth of the coppice-wood is taken into consideration. Ash, chesnut, whitethorn, and hornbeam are the sorts to be preferred for a coppice.

In some places allotments of land have been let to cottagers, which, where it has been judiciously done, has added much to their comfort, and stimulated industry by giving employment to women and children.

RYE is a plant of the family of the Gramineæ, and bears naked seeds on a flat ear furnished with awns like barley. The straw is solid, the internal part being filled with a pith, which, if it causes it to be inferior as fodder, makes it more valuable for litter, and still more so for thatching. The value of the straw is often nearly equal to that of the grain. Rye grows on poor light soils which are altogether unfit for wheat, and hence tracts of light sands are often denominated rye-lands. On these soils this grain is far more profitable than wheat, which can only be raised there at a great expense of marling and manuring. The value of rye in those countries where it forms a considerable portion of the food of the labouring classes is from two-thirds to three-fourths of that of wheat. From experiments made to ascertain the quantities of nutritious matter in rye and wheat, Thaer states their real comparative value to be as 64 to 71. It was formerly raised in considerable quantities in England, either alone or mixed with wheat, and was then called *meslin*, from the old French word *meslé*, which means *mixed.* The meslin when ground produced a very wholesome and palatable household bread, and it was thought advantageous to sow the two sorts together, from the notion that if either failed there would still be a crop of the other. This however was an error. No doubt the wheat would often fail on inferior soils when the rye would thrive; but the reverse was seldom or never the case; and besides the rye comes to maturity at least a fortnight before the wheat. If the soil is capable of bearing a moderate crop of wheat, it would be much more advantageous to sow one portion of a field with rye and another with wheat; and if meslin bread is desired, the two grains may be mixed in any required proportion. Excellent bread is made of two parts of wheat and one of rye ground together, with only the coarse bran sifted out. Rye is at present raised in very small quantities in England. By examining the averages taken for the purpose of regulating the duty on the importation of corn, the quantity of rye sold is insignificant compared with that of other grain. Except at the time when it is sown for the purpose of affording green food for sheep and horses in spring, there is no demand for rye in the markets. In the Return now before us, made January 8, 1841, for the preceding week, the quantity of wheat sold is stated to be 68,990 quarters, and of rye only 258; and while the average price of wheat was 3*l.* 1*s.* 9*d.*, and barley 1*l.* 13*s.* 6*d.*, that of rye was only 1*l.* 12*s.* 6*d.*, which is much below its comparative value, according to Thaer's experiments, either to make bread of its flour or to distil a spirit from it.

Rye is extensively cultivated on the Continent, especially in the Netherlands, where it is the chief grain from which the spirit commonly called Hollands is distilled, which is flavoured with juniper, in Dutch called *Genever*, whence the name of *geneva* and its contraction *gin.* When malted it makes excellent beer, one bushel of rye malt being equal to at least one and a quarter of barley malt. The cultivation of rye is very simple; it is usually sown after wheat, where the soil is light and rich, or after turnips and potatoes, in those soils which are not strong enough for wheat. As it is ripe in June or July, turnips are often sown immediately after; and by the manure produced by these, as well as their effect on the soil, a second crop of rye can be obtained the ensuing year. This is no doubt contrary to all sound theory; but such is the practice in Flanders, and they do not find that their crops diminish in consequence.

In England rye is mostly sown as a green crop, and when fed off early in spring with sheep, the land is invigorated, and will bear excellent potatoes or turnips the same year. This practice cannot be sufficiently recommended; and if the rye is sown very early in autumn, it may be fed off in October and November, when sheep-feed is beginning to fail and the turnips have not yet attained their full size, without any detriment to the succeeding spring produce.

Winter barley and winter oats have been substituted for rye as spring fodders by some farmers; but on land of moderate quality rye is generally preferred. It bears the severest winters, which is not the case with barley or oats. The rye which has been fed off very early may be allowed to remain for seed, which it will produce more or less abundantly, according as it has been fed off earlier or later.

The preparation of the land for rye is the same as for wheat, except that in very light soils no more ploughings are required than will clear the ground of weeds. If rye is sown after harvest, one ploughing only is usually given. It will thrive upon rich wheat soils, as well as upon lighter, and, as it throws out numerous stems in rich land, it is the more profitable as fodder, although the crop of grain might not be so abundant when the plants are too much crowded. To have as much green food as possible, the rye is always sown broadcast, three bushels at least to an acre; some sow a sack, and with advantage. It is also usually sown amongst winter tares, which the stems of the rye help to keep up from the ground: half a bushel of rye to three bushels of tares is a fair proportion; some farmers sow wheat instead of rye, as being stronger in the stem, but besides its being more expensive, it does not shoot so early as rye, nor is it so much stronger in the green stem as is supposed. Oats are invariably sown amongst spring tares, and answer the purpose well.

There is a variety of rye mentioned by continental authors by the name of *Seigle de la St. Jean*, or St. John's-day rye, because it grows so rapidly that, if sown about St. John's Day (24th of June), it will be fit to mow green by the middle of September, and in favourable seasons may be fed off again in November, without preventing its giving ample feed in spring, and a good crop of grain at the next harvest. It might be advantageous to introduce this variety into England, if it be not already known. There is no doubt that there are varieties of the same kind of plants which have a much more vigorous vegetation than those commonly cultivated; and the introduction of them where they are not known is an important benefit to agriculture. The celebrated agriculturist Du Hamel du Monceau mentions an individual who had obtained, from one sowing, five abundant cuts of green rye for cattle in two years. If any green plant is cut down before the fructification is completed, it will in general throw out fresh stems; and in very rich soils its blossoming may thus be continually retarded until the roots become too weak to force successive stems.

When the land is in good heart and clean after wheat-harvest, it may be expeditiously cultivated by means of a strong scarifier, such as that lately invented by Mr. Biddel, or some similar instrument, which opens the soil several inches deep, without turning it over; and rye may be sown immediately, without using the plough. This is an immense saving of time and labour, as four or at most six horses, will completely stir ten acres of land in a day, which may thus be immediately sown before the wheat is out of the field, or fit to be carried. A week gained in the time of sowing may make all the difference between a crop which can be eaten off before winter and one which will only be fit for the sheep in the succeeding spring. The weeds which may spring up with the rye will either be choked by its luxuriance, or at all events will never shed their seeds, being mown or fed off with the rye, and the roots ploughed in the next year. The large perennial roots will thus be more easily taken out than by the harrows, and all the annual weeds will be destroyed.

Although the value of rye as a green crop is fully admitted in England, very little is grown for food or distillation, yet on some poor soils, where wheat and barley are now often sown with a very poor return, and at a great expense of manure, rye and buckwheat would give a much greater clear profit, and would require much less manuring: and where there are not ready means of improving the soil by claying or marling, the cultivation of rye would be found most advantageous; and, by means of sheep, very poor sandy soils might thus be made profitable.

Rye is subject to most of the diseases which attack the plants of the family of the Gramineæ, such as rust, mildew, burnt ear, and smut-ball. But there is one remarkable disease, which, although it is sometimes found in wheat, is much more commonly observed in rye. It is called the *ergot*, the French name of a cock's spur, which the diseased grain resembles in shape. By some perversion of the vital functions of the plant, the embryo or germen, instead of growing into a regular seed filled with farina, shoots out a long black fungus-like substance, several times the length of a common seed, which rises above the chaff, and has the appearance of a slender pyramid, slightly bent on one side. This substance is soft, and easily broken or cut, and is uniform in its internal texture, without any husk or skin over it. If it were merely the loss of the grain of which the ergot takes the place, the mischief occasioned by this disease would be comparatively trifling; but this fungus, when taken internally, mixed with the rye flour converted into bread, has a most powerful and deleterious effect on the animal frame. When taken in any considerable quantity, it produces the most dreadful diseases. This was first observed in France, where a great scarcity from the failure of the crops, accompanied with a more than usual production of the ergot in rye, obliged the poorer inhabitants of certain districts to make bread from diseased rye. The consequences were horrid to behold; their limbs rotted and separated from the trunk before death relieved them from their misery. The ignorant ascribed it to witchcraft, but experiments made on animals by feeding them on ergotted rye, soon showed the real cause. A similar effect is recorded, and supposed to have been produced by the ergot of wheat on a family in the parish of Wattisham, Suffolk, in 1762, of which an account appeared in the 'Philosophical Transactions' for 1762, and which is mentioned by Professor Henslow, of Cambridge, in a paper on the diseases of wheat, in the 'Journal of the Royal Agricultural Society of England' (vol. ii., No. 1, page 17).

The extraordinary effects of the ergot of rye have made it the subject of experiments in medicine, and it has been found extremely useful in certain cases of protracted labour. It is consequently become an article of commerce as a drug, and imported from the Continent. By an attentive observation of the circumstances which favour this disease in the rye, it might be profitable to cultivate the plant expressly for the ergot it produces. The seed which grows on the same ear with the ergot might be selected for seed, and a cold wet soil, with an ungenial aspect, might be chosen as most likely to perpetuate the disease. The ergot is sold by druggists at from ten to twenty shillings per ounce, so that, if only a pound of ergot could be collected, it would be worth more than the produce in sound grain of an acre of the best land. At all events, it will well repay the trouble of picking out the ergot from the rye, where it is infected, and it is easily discovered, before reaping, from its prominence and black colour.

RYE-GRASS, sometimes called *Ray-Grass*, is one of the most common of the artificial grasses; it is of the family of the *Gramineæ*, of the genus *Lolium*. There are several varieties, some annual and others perennial, some producing a strong juicy grass, and others a small diminutive plant. These varieties arise chiefly from difference of soil, climate, and cultivation. In the convertible system of husbandry, rye-grass performs a very essential part, especially the perennial sort, which, mixed with different varieties of clover and other grass-seeds, produces a rich and close herbage, which may be either mown for hay or depastured. In the course of two or three years the land is so much recruited by the extension of the roots, and by the dung and urine of the animals, that, without dung from the yard, it will produce one or two very good crops. When clover is sown to remain only one year, the annual variety of rye-grass is frequently sown with it. It adds to the weight of the hay, and the stems of the rye-grass are a good corrective to the richness of the clover, when they are given to horses in a green state; but when the hay is intended for the London market, or that of any of the great mercantile towns, the tradesmen and carmen prefer the pure clover hay, thinking it more nutritious. Some farmers also who cultivate their land on the Norfolk system, have a prejudice against rye-grass, as being unfavourable to the succeeding crop of wheat. Accordingly, when they have a layer of rye-grass, instead of clover (because the clover, having been too often repeated, fails in the end), they often take peas or beans between the rye-grass and the wheat. This accords with theory; for when the rye-grass completes its fructification, even if the seed is not ripe, it has a deteriorating effect on the soil, similar to that of a white crop, and therefore a leguminous crop should succeed it. Many farmers, without being able to give any reason, assert, from experience alone, that wheat taken after rye-grass is more subject to accident or failure than after red clover. This is not the case when the rye-grass has been depastured, but in the convertible system generally adopted in Scotland, oats are usually sown when the grass is broken up, because an abundant crop is obtained on a single ploughing; and the land requires stirring to produce a good crop of wheat, which is taken in preference after beans or early turnips.

Different varieties of rye-grass have been recommended at various times: one which goes by the name of *Pacey's* rye-grass has kept its reputation as a perennial grass for a long time. The *Italian rye-grass*, well known in the south of France, in Switzerland, and in Germany, is a native of Lombardy, where it grows most luxuriantly and rapidly by means of irrigation. There is no grass which so soon forms a water-meadow. It has been brought into notice in England within a few years, in consequence of small parcels of the seed having been brought over by individuals who admired its qualities; and it has borne the cold and wet winters of Britain better than might have been expected. On rich moist land it grows most rapidly and luxuriantly. It will bear several cuttings in a season. The writer of this article has had two perfect crops of seed from the same plants in one year, the first in June and the second in October, both perfectly ripe and heavy. Those who have paid attention to the cultivation of rye-grass think highly of it. This grass grows much more rapidly in spring than any other grass, and is so much relished by cattle, that they scarcely allow a single stem to spring up. A small space in a layer being sown with Italian rye-grass, may be distinguished in the pasture by its superior green colour and its very close pile; and the cattle will always be found there as long as there is the least bite for them. It may be advantageously sown in autumn with the Trifolium incarnatum, and together they will give much early green food in spring. It may be a question, whether this is preferable to sowing rye; but it affords a variety, and on some soils may produce earlier and more abundant feed for lambs. When Italian rye-grass is sown by itself, and allowed to go to seed, it becomes thin after the first year, from many of the plants dying off: it may therefore be prudent to mix some other kinds of grasses with it, which will supply its place where it is worn out. It is a most excellent practice to sow Italian rye-grass on old meadows and pastures, at the time when they are recruited with compost or earth. If they are well harrowed or scarified, and the rye-grass be sown before the roller goes over them, the succeeding crop of hay will be much increased in quantity and improved in quality. On water-meadows which require renovation, this grass is invaluable, being early, rapid in growth, and very abundant when irrigated. We have seen hay made in July from a newly made water-meadow sown with Italian rye-grass in March. This was at Mr. De Fellenberg's, at Hofwyl, near Berne, in Switzerland. Mr. J. Rodwell, at Alderton Hall, near Woodbridge, in Suffolk, cultivates the Italian rye-grass for seed to a large extent, and with great success.

SAINFOIN, *Hedysarum onobrichis,* is a plant of the family of the Leguminosæ, which grows luxuriantly and spontaneously on the calcareous mountains of the middle and south of Europe. It has been in regular cultivation for upwards of two centuries for the purpose of supplying fodder for cattle, either in the green state or when converted into hay. There are few plants which have more rapidly improved the value of poor thin calcareous soils than sainfoin; and in the richer kinds of loam, which contain a considerable proportion of calcareous matter, its value surpasses even that of broad clover, giving fully as great a return, with a much smaller expenditure of manure. The plant has a strong woody and fibrous root, which insinuates itself into the fissures of calcareous rocks, and finds moisture in the dryest seasons, while its spreading fibres keep the earth from being washed down the steep slopes of the hills. Being nearly perennial, or at least of many years' duration, it binds the soil together. In favourable situations, it may be made into hay twice in the year, or cut oftener as green fodder. In the most arid and exposed situations, it gives at least one good crop of hay. The plant grows about two feet high, and the stem, which branches out into many compound leaves, is crowned with a beautiful spike of flowers of the papilionaceous kind. After it has been mown, it shoots out rapidly again, and may be advantageously depastured by every kind of cattle or sheep. There are varieties of the plant which differ in the rapidity of their growth: the best is called in France *esparcette* or *sainfoin à deux coupes.* From France it has been introduced into England. The duration of sainfoin depends on the nature of the soil, and the state it was in with respect to weeds when it was sown. A cold wet subsoil soon destroys the roots, whereas a free and dry one, whether rocky or gravelly, gives them vigour. Grass and weeds, which choke the crown of the plant, soon cause it to decay, as is the case with lucern. With every advantage, it may last in vigour ten years, especially if it is occasionally invigorated with a top-dressing of manure or ashes, or, which is best of all, with diluted urine, or the drainings from dung-hills. During that time it may be cut twice for hay every year, taking care to cut it before the flower is faded or the seed formed; and if sheep are folded on it after the second cutting, the next crop will well repay the trouble. It is usually sown in spring in a crop of barley or oats, which should be sown thin in order that the sainfoin may not be smothered. The land should have been prepared by a cleansing crop, such as turnips fed off by sheep folded on them. From three to four bushels of seed may be sown, harrowed in, and rolled. It is not often drilled, although this method, by allowing the use of the hoe between the rows, would much strengthen the young plants, and protect them against coarse grasses, which are their greatest enemies. In the first year the sainfoin should not be fed off by sheep; and if it is mown, it should not be mown too close to the ground. The crown of the root in the young plant rises a little above the ground; and if this be bit off, or cut with the scythe, the plant dies. It is useful to harrow the ground lightly, to draw the earth round the roots, and to destroy seed weeds soon after the barley or oats are reaped. The sainfoin does not produce a large crop the first year; for some of the seeds will lie a twelvemonth in the ground before they spring up. It is in perfection after the second year, when a portion may be reserved for seed. Sainfoin hay is extremely nourishing for every kind of cattle, especially if it has been made without rain. Although it is not apt to heat in the stack, it must be put up in a very dry state; and if it has suffered from rain, too much care cannot be taken thoroughly to dry it; for the water insinuates itself by capillary attraction into the hollow stems, and is long in evaporating, so that when it feels quite dry it may yet contain much water. The mode of discovering this is to twist it strongly in the hands into a rope, when the moisture, if there is any, will ooze out. It is better to let it dry thoroughly, than, by carrying it in a hurry, to run the risk of its becoming mouldy within. In very precarious seasons it may be carried in a green state, provided there be no mois ture in it from dews or showers, and stacked in alternate layers with good straw. It will impart some of its fragrance to the straw, and lose none of its nutritive qualities. The same may be done with lucern or clover. The most advantageous use of sainfoin, however, is to cut it green and give it immediately to the cattle. There is no danger of their being hoven by it, for it ferments very slowly, owing to the fibrous nature of the stem. If the situation of the field admits of occasional irrigation, without danger of the water stagnating, the produce of the sainfoin will be greatly increased; and it may then be cut four or even five times in a season without fear of exhausting its strength. When it begins to appear thin on the ground, and other plants seem to get the better of the sainfoin, it is time to break it up. The land will be found much improved in fertility by the sainfoin. A poor chalk or gravel, which before would scarcely repay the seed sown in it, will now, by the gradual decay of the roots and fibres of the sainfoin, produce several good crops without any other manure. The prudent farmer, however, will not entirely destroy, by repeated crops of grain, that cohesion of the soil which is produced by the roots of the sainfoin; but by a judicious course and proper application of the manure, which the sainfoin enabled him to make, he will keep up the newly acquired fertility until, in the course of ten or twelve years, he can again sow sainfoin seed in it with the prospect of a crop more abundant than the first. Many a poor barren tract of calcareous rock and gravel has been fertilised and raised in value by the sole effect of the sainfoin, without which it must have remained in its unproductive state.

Although a chalky soil is best adapted to the growth of sainfoin, it may be sown with advantage in all light loams, provided the substratum be sound and dry. On very rich deep moulds lucern is a more profitable crop; but sainfoin will thrive where lucern would fail; and it is particularly adapted for poor dry soils.

There is nothing peculiar in the manner in which sainfoin is made into hay. It should not be shaken about too much, for fear of injuring the flower and breaking off the leaves. The swarth should be merely turned over, when dry on one side, and then, as soon as it is dry through, it should be put into small cocks, occasionally spread out in the sun, when the dew is off the ground, and carried to the stack as soon as it is sufficiently made. It should take a good heat in order to make it compact, but without acquiring too dark a colour. Experience alone can teach the exact time when it should be stacked. When it is left for seed, it should be examined carefully after the blossom fades. The lower pods will be filled with ripe seed before the blossoms at the top of the spike of flowers are withered or the seed formed in them. If the sainfoin were left standing till these seeds were ripe, the lowest would be shed; but by cutting it at a proper time these may be preserved, while most of the latter will ripen in the straw sufficiently to vegetate when sown. Rainy weather is very injurious to the seed crop; a fine time should therefore be selected, if possible, even at the risk of a smaller crop. The seed is only gathered for sowing; but in case there should be more than is required for that purpose, and no ready sale, it is excellent food for horses. The produce varies from three to five or even six sacks per acre. It is easily thrashed out, and this operation is often done on a cloth in the field, when the weather permits. It is readily done by a thrashing-machine, and winnowed like corn. On the whole, there are few plants the cultivation of which is so advantageous as that of sainfoin on the soils on which it thrives best.

SCYTHE. The common scythe is an instrument too well known to require a minute description, but as much of its utility in agriculture depends on a correct adjustment of its parts, we shall briefly advert to them. The blade of the scythe, which is always curved, with the cutting edge on the concave side, is fixed to the handle at an angle both to the plane of the blade and to the tangent to the curve. It is on the nice adjustment of these angles that the perfection of the instrument depends. A scythe must cut the corn or grass, especially the latter, as near to the ground as possible, and where the land lies flat and the stones have been removed from the surface, a good scythe, in the hands of a skilful mower, will cut the grass so near to the ground that little or no stubble is left. Every farmer knows well that an inch of the grass near the ground adds more to the weight of the hay than several inches higher up, and that a skilful mower with a good scythe can easily add much more to the value of the crop than his earnings amount to, however liberally he may be paid, and that it is of the greatest importance that none but the best mowers be entrusted with the work, and that attention be paid to the form of their scythes and to their being frequently whetted.

It is the custom in England for the mowers to stoop much in mowing, by which they imagine that they have a wider sweep. The angle at which the handle is fixed is very acute to the plane of the blade. In other countries the mowers stand more upright, and a longer handle gives them a greater radius. Habit makes that position easier to which we have been long accustomed; but it is probable that a man can endure fatigue, and continue his exertion the longer, the more nearly his position is erect. In some countries the handle of the scythe is nearly straight, and the end of it passes over the upper part of the left arm. The position of the mower is then nearly erect, and his body turns as on a pivot, carrying the blade of the scythe parallel to the ground, and cutting a portion of a considerable circle. The position of the handle in this case must be such that when the scythe is in the middle of its swing, and the blade parallel to the ground, it rests naturally on the left arm above the elbow, while the mower is nearly in an erect position. By turning his body to the right, and stooping towards that side, he begins his cut, and by raising himself up, the muscles of his back greatly assist in swinging the scythe round.

The blades of the scythes on the Continent are mostly made of natural steel, such as is found in parts of Germany, and they are so soft that the edge can be hammered to sharpen it and keep it thin. In England the scythes are forged thin and well tempered, and to prevent their bending they have a rim of iron along the back to within a few inches of the point. This saves much time in sharpening, and they very seldom require the grindstone.

Most scythes have two projecting handles fixed to the principal handle, by which they are held, and these are variously put on, according to the fashion of the district. The real line of the handle is that which passes through both the hands and ends at the head of the blade. This may be a straight line or a crooked one, generally the latter, and by moving these handles up or down the main handle, each mower can place them so as best suits the natural size and position of his body. Hence it is that a man can seldom mow well with another man's scythe.

In mowing corn when ripe, which is an economical mode of reaping, the scythe need not have so great a sweep; nor is it necessary to cut the straw so near to the ground. The great difficulty here is to lay the cut corn evenly, so that the binders can readily collect it and tie it into sheaves. This is most effectually done by adding to the bottom of the handle a small hoop at right angles to the line of cutting, and by mowing always towards the standing corn, which is easily done by beginning at one end and going round toward the left in an irregular spiral to the centre of the field. The straw is thus laid leaning against the standing corn, and is readily collected with the arm by the binder, who follows the mower. As the straw is not always upright, but frequently bent to a side, this mode of mowing is not always practicable. When the corn is only slightly bent down, a scythe with an addition of a cradle, as it is called, collects the slanting straw more easily. The cradle is a species of comb with three or four long teeth parallel to the back of the blade, and fixed in the handle. This inserts itself behind the straw to be cut, raises it up, and, by a peculiar twist of the scythe after the stroke, it is left so as to be easily collected. Those who are accustomed to use the cradle-scythe do the work rapidly and well.

When the corn is much laid and entangled, it is impossible to use the common scythe, even with a cradle. This has probably suggested a scythe to be used with one hand, while a hook in the other gathers the straggling corn. The most perfect of these scythes is called the *Hainault scythe*, from a province of that name in Belgium, where it was first noticed. It is commonly used in different parts of the Continent. The Hainault scythe is swung by the power of the wrist principally. It does not cut the straw by so oblique a stroke as the common scythe, but rather as a bill-hook or axe would do, meeting the straw nearly at right angles. The hook collects a small bundle, which is severed at a stroke, and the left foot assists in holding what is cut and rolled together with the hook, in the hollow of the blade. It is thus laid aside, and fit to be tied up. This instrument is a great improvement on the English fagging-hook, which is used in the same manner, the left arm of the reaper acting the part of the hook; but as the handle is inserted in the plane of the blade, it causes the reaper to stoop low, which is fatiguing to the loins, especially of elderly people, who can more readily reap with the Hainault scythe.

The scythe is an instrument which should be more generally introduced in harvest, and experience has proved that it had many advantages over the sickle or reaping-hook. [Harvest.]

SHEEP. The sheep, according to Cuvier, belongs to the class *mammalia*, the young being nourished with milk from the mammæ or teats of its mother; to the order *ruminantia*, with four stomachs, and the organs of digestion disposed for chewing the cud; to the tribe *capridæ*, with horns persistent, and placed on an osseous nucleus; and to the genus *ovis*, with or without horns, but these when present uniformly taking, to a greater or less degree, a lateral and spiral direction. The forehead of the sheep is arched, and protruded before the base of the horns; there are no lachrymal ducts, the nostrils are lengthened and oblique, and terminate without a muzzle; there is no beard properly so called, the ears are small, and the legs slender. The hair is of two kinds, one hard and close, and the other woolly—the wool preponderating in proportion as the animal is domesticated. The sheep is principally distinguished from the goat by his convex forehead, by his spiral horn not projecting posteriorly, and more especially, and that in proportion to the care which is bestowed upon him, by the preponderance of wool over the hair, with which, in despite of every effort, the Cashmere goat is covered.

The history of the sheep may be traced to the remotest antiquity, for the care of it was committed to the younger son of the first man. 'Abel was a keeper of sheep.' What other animals were then domesticated is not known; but one purpose to which the sheep was devoted is recorded in the sacred volume: 'Abel brought as an offering to the Lord the firstlings of his flock, and the fat thereof.' Not a word is said of this animal being used for human food until after the flood. Man ate of 'the herb of the field,'—'in the sweat of his face he ate bread;' but to Noah it was first said, that 'every thing that liveth shall be meat for him.' The probability however is, that the flesh of the sheep and other animals formed, even in the earliest period, a portion of human food; and it is recorded of Jubal, a son of Cain, that he 'was the father of such as dwell in tents and have cattle.' The tents were formed of the skins of the animals which they bred; and it can scarcely be imagined, that when the skins were thus disposed of, the flesh would be entirely thrown away. The sheep mentioned in holy writ were horned; for when Abraham had led his son Isaac to the mount of sacrifice, he was arrested by a heavenly voice, and saw behind him a ram caught in a thicket by his horns.

There is a breed of sheep now extending over the north and south of Asia, and Palestine, and Russia, and of which the flocks of the Calmucks and Tartars of the present day are almost entirely composed. They are distinguished by two hemispheres of fat commencing at the loins, gradually swelling into a considerable mass towards the rump, and presenting behind two enlargements of a more or less globular form. The owners of the modern improved breeds would find great fault with some points about them; but many of their defects have doubtless been the result of neglect.

Some naturalists have traced the origin of the sheep to the Argali or the Mouflon. The Argali is a species of mountain-sheep, found in small flocks on the high grounds of Asia, extending from the precipices of Khamtchatka in the north to those of Mongolia in the centre, and of Caucasus in Western Asia. The Mouflon is an inhabitant of Southern Europe, Corsica, Crete, and the islands of the Grecian archipelago. They congregate in large groups, and possess all the wildness of the Argali. Neither of these however has the slightest claim to being the original parent of the sheep. They are descendants of those who have escaped from the dominion of man, and are retreating from desert to desert in proportion as the population of the country increases.

Moufion, or Musman, of Corsica. From a specimen in the British Museum.

It will be most satisfactory to the reader to commence with the history of the British sheep, and then compare with them the breeds and management in other countries. The records of olden times are very unsatisfactory with regard to the existence of the sheep in Britain. No early historian makes the slightest mention of them. Even Cæsar, who describes so much at length the employments and habits of the British, never alludes in the most distant manner to the sheep, or the employment of its wool. The subjugation however of Britain being completed, the conquerors turned their attention to the improvement of the country; and among other things they established a woollen manufactory at Winchester, supplied by the native fleeces of the country, for from no other source could it be obtained. So well did this succeed, that the woollen cloths of Britain soon began to vie with and excel the productions of every other part of the Roman empire. The finest and most expensive dresses used on days of festivity or ceremony were procured from Britain. The sheep employed in furnishing the material of these productions were *the short-woolled breed.* Winchester was situated in the centre of a country which then, as now, could support short-woolled sheep alone.

After this history is silent as to the sheep and its productions for some centuries, until an old chronicler gives a pleasing picture of the manners of the age when Alfred reigned, of whom it is said—

> 'His godemether ofte smal gyftes to him she kindly toke
> Vor to leve other plé, and loke upon his boke.'

This godmother is described as being skilled in the spinning of wool herself, and busied in training her daughters to the same employment.

It would appear from this that *the long wool* had now begun to be employed, although the manufactures of the Winchester mills continued to be duly estimated, and, in point of fact, the cultivation of the various breeds of sheep, and the manufacture of the fleece into many different kinds of cloth, had begun to constitute the chief employment and wealth of the country; and so it has continued to the present day.

Different names are given to the sheep, according to its sex and age. The male is called a *ram* or *tup*. After weaning he is said to be a *hog*, a *hogget*, or *hoggerel*, a *lamb-hog*, or *tup-hog*, or *teg*; and if castrated, a *wether hog*. After shearing and when he is probably a year or a year and a half old, he is called a *shear hog* or *shearling*, or *dinmont*, or *tup;* and when castrated a *shearing wether*. After the second shearing, he is a *two shear ram*, or *tup* or *wether*. At the expiration of another year, he is a *three shear ram*, &c.

The female is a *ewe* or *gimmer lamb* until weaned, and then a *gimmer* or *ewe hog* or *teg*. After being shorn, she is a *shearing ewe* or *gimmer*, or *theave* or double-toothed ewe, and after that, a *two*, or *three*, or *four*, or *shear ewe* or *theave*. The age of the sheep is reckoned, not from the period of their being dropped, but from the first shearing.

The teeth give certain indications as to the age. The sheep has no incisor teeth in the upper jaw; but there is a dense elastic cushion or pad, and the herbage, firmly held between the front teeth in the lower jaw and this cushion, is partly bitten and partly torn asunder. The sheep has the whole of the incisor teeth by the time that he is a month old, and he retains them until the fourteenth or sixteenth month. They then begin to diminish in size, and are displaced. The two central ones are first shed, and the permanent ones supply their place, and attain their full growth when the animal is two years old. Between two and three, the next pair are changed; the third at three years old; and at four, the mouth is complete. After this there is no certain rule, until, two years more having passed, the teeth one by one become loosened and are lost. At six or seven years of age the mouths of the ewes should be occasionally examined, and the loose teeth removed, and then, by good pasture and good nursing in the winter, they may produce lambs until they have reached the ninth or tenth year, when they begin rapidly to decline. Some favourites have lingered on to the fifteenth or sixteenth year; but the usual and the most profitable method is to fatten and dispose of the ewes when they are five or six years old, and to supply their places by some of the best shearing ewes.

The rings at the base of the horns afford very imperfect indications of the age of the sheep. When untouched, they are little to be depended upon, and their natural irregularities are too often filed away by dishonest dealers.

The history of the British sheep will be most naturally divided according to the quantity and quality of the wool of the different breeds, the uses of the skin, and the quantity and quality of the flesh. The covering of the original sheep consisted of a mixture of hair and wool; the wool being short and fine and forming an inner coat, and the hair of greater length, projecting through the wool, and constituting an external covering. When the sheep are neglected or exposed to a considerable degree of cold, this degeneracy is easily traced. On the Devonshire moors, the mountains of Wales, and the highlands of Scotland, the wool is deteriorated by a considerable admixture of hair. Even among the South Downs, the Leicesters, and the Ryelands, too many *kemps* occasionally lessen the value of the fleece. It is only by diligent cultivation that the quantity of hair has been generally diminished, and that of wool increased in our best breeds.

The filaments of wool taken from a healthy sheep present a beautifully polished and even glittering appearance. That of the neglected or half-starved animal exhibits a paler hue. This is one valuable indication by which the woolstapler is enabled to form an accurate opinion of the value of the fleece. The mixture of hair in the wool can often be detected by close examination with the naked eye, but most readily by the assistance of a microscope.

Among the qualities which influence the value of the wool are *fineness*, and the uniformity of that fineness in the single fibre and in the collected fleece. This fineness however differs materially in different parts of the fleece. It prevails on the neck, the shoulders, the ribs, and the back. It is less on the legs, thighs, and haunch, and still coarser on the neck, the breast, the belly, and the lower part of the legs. The fineness of the wool is considerably influenced by the temperature. Sheep in a hot climate yield a comparatively coarse wool; in a cold climate, they carry a closer but a warmer fleece.

The fineness of the fleece is also much influenced by the kind of food. An abundance of nutriment will increase both the length and the bulk of the wool. This is an important consideration with the sheep-breeder. Let the cold of winter come—let it continue for a considerable period, yet if the sheep is well kept, although the fleece may lose a little weight, this will be more than compensated by its fineness and increase of value. If the sheep however is half-starved while he is exposed to unusual cold, the fibre of the wool, although perhaps somewhat finer, will be deficient in weight and strength and usefulness.

That which is called *trueness of staple*, or the fibres being of an equal size, is of much importance in the manufacture of wool, for whenever the wool assumes an irregular and shagged or *breachy* appearance, there is a weakness in the fibre and will be an irregularity in the manufacture, especially if the fleece is submitted to the operation of the comb. Connected with this, and a most important quality, is the *elasticity* of the woolly fibre—the disposition to yield, or submit to some elongation of substance, some alteration of form, when it is distended or pressed upon, and the energy by means of which the original form is resumed as soon as the external force is removed.

Referrible to this elasticity or yielding character of the wool is its *pliability* and *softness*, and without which no manufacture of it can be carried to any degree of perfection. The last quality which it is necessary to mention is its *felting* property; that quality by which it may be beaten or pressed together and worked into a soft and pliable substance of almost any size and form. It would seem that the process of felting is of far older date than that of weaving, and it is still continued not only by the nomadic tribes of south-eastern Europe and of Asia, but it is made occasionally to vie with the finest productions of the loom.

Some late microscopic observations have unravelled the whole mystery of felting, and of the employment of wool in almost every form. The fibre, examined under a powerful microscope, appears like a continuous vegetable growth, from which there are sprouting, and all tending one way, from the root to the other extremity, numerous leaves, assuming the appearance of calices or cups, and each terminating in a sharp point. It is easy to conceive how readily one of these fibres will move in a direction from the root to the point, while its retraction must be exceedingly difficult, if not impossible. It was a fibre of Merino wool that was first submitted to microscopic observation, and the number of these serrations or projections counted. There were 2400 in the space of an inch. A fibre of Saxon wool finer than that of the Merino, and of acknowledged superior felting quality, was substituted. There were 2720 serrations. A fibre of South Down wool, in its felting power well known to be inferior to that of the Saxony and the Merino, was placed in the field of vision. There were only 2080 serrations in the space of an inch, or 640 less than the Saxony exhibited. The Leicester wool is acknowledged to possess a less felting property than the South Down. There were only 1860 in the space of an inch.

There can be no doubt as to the structure of the woolly fibre. It consists of a central stem or stalk, from which there spring at different distances circlets of leaf-shaped projections, possessing a certain degree of resistance or of entanglement with other fibres, in proportion as these circlets are multiplied and they project from the stalk. They are sharper and more numerous in the felting wools, and in proportion as the felting property exists. They are connected with, or, it may be confidently asserted, they give to the wool the power of felting, and regulate the degree in which that power is possessed.

The skin of the sheep is often partially tanned, and then used in the common sorts of book-binding; or it is manufactured into parchment, and becomes exceedingly valuable on account of its durability. Immense numbers of lambskins are dressed in a peculiar way, and converted into gloves with the wool remaining on them, or used in some countries for the linings of valuable garments. It is scarcely credible to what degree vanity and cruelty are sometimes carried. The ewe is slaughtered a little before the time when her pregnancy would have expired, and the lamb is taken from the womb and immediately destroyed. It is supposed that the fur nearest to the skin is more beautiful than could have been obtained from the same animal after birth.

As for the carcase of the sheep, it is comparatively lately that even in Great Britain it has been regarded in the light that it deserves. In many foreign countries it is disliked, or at least rarely eaten. The Calmucks and Cossacks seldom touch it. Even in some parts of America there is a prejudice against it. It is an object of little or no value in Spain; and, except among the poorest, it is not there considered fit for food. Since the British sheep-master has begun, and judiciously, to look more to the profit to be derived from the carcase; since the system of artificial feeding has been brought to so great perfection, and a far greater number of sheep can be fed and perfected on the same number of acres, perhaps the wool may have somewhat altered in character. It has grown in length, and it has increased in bulk of fibre. It has not deteriorated, but it has changed. If no longer fit for the purposes to which it was once devoted, it has become suited to others. The increase of the number of fleeces, and the increase of weight in each fleece, go far to compensate for the diminution of price, while the improvement of the carcase more than supplies the deficiency, if, in truth, there was any deficiency to supply.

It has been proved by authentic documents, that the number of sheep in the United Kingdom has been more than trebled in the last one hundred and fifty years. How was this managed?—for it was supposed that no more than a given number of sheep could be kept on a certain space of ground. The quantity of ground was rapidly increased, and much that was formerly deemed unworthy of cultivation was rendered productive; but more effective than this was the new system of husbandry that was introduced—the artificial or turnip husbandry, by which a regular supply of food could be provided for every season. With this was connected the attempt to fatten sheep still more expeditiously than could be accomplished by any former method. This succeeding beyond his most sanguine expectations, the sheep-master next attempted to increase the size of the breed. He had not, however, sufficiently taken into account a consequence of this. As the carcase increased in size, the wool became longer, heavier, and coarser. The breeder would not see this at first; but he soon began to find that the manufacturer would not purchase it, for it could not be used for the purposes to which it was formerly applied. His stock accumulated; it weighed heavily on his hand. Still he would not believe that his once favourite and yet valuable wool was deteriorated, although he was compelled to sell it at a diminished price. And what was the consequence? Why that he had no just reason to complain; for the early maturity of the sheep, and the continued value of the wool for many important purposes, rendered his profits greater than they were before he had begun to alter his system.

It will now be proper to take a rapid survey of the different breeds of sheep, commencing with the *South Downs;* for by them, or their congeners, the first manufactory at Winchester was supported. The South Downs, and the Hampshire and Wiltshire breeds, were formerly, according to Mr. Ellman, of 'a very small size, and far from possessing a good shape, being long and thin in the neck, high on the shoulders, low behind, low on the loins and on the rumps, the tail set very low, perpendicular from the hip-bones, sharp on the back, the ribs flat, but good in the leg, although having big bones.'

It is pleasing to compare this with the account given by the same breeder of the South Downs of the present day; the change being effected by him and a few spirited individuals:—'The head small and hornless; the face speckled or grey, and neither too long nor too short; the lips thin, and the spaces between the nose and the eyes narrow; the under-jaw fine and thin; the ears tolerably wide, and well covered with wool; the forehead also, and the whole space between the ears, well protected by it, as a defence against the fly.

'The eyes full and bright, but not prominent; the portion of the frontal bone arching the eye not too prominent, that it may not form a fatal obstacle in lambing.

'The neck of a medium length, thin towards the head, but enlarging towards the shoulders, where it should be broad and high, and straight in its whole course above and below; the chest wide, deep and projecting between the fore-legs, indicating a good constitution and a disposition to thrive; the shoulders on a level with the back, and not too wide above, but bowing outward from the top to the breast, leaving room for the springing rib behind.

'The ribs coming out horizontally from the spine, extending far backwards, and the last rib projecting more than the others. The back flat from the shoulders to the setting on of the tail; the loin broad and flat; the rump long and broad, and the tail set on high, and nearly on a level with the spine; the hips wide; the space between them and the last rib on either side as narrow as possible, and the ribs presenting a circular form like a barrel.

'The belly as straight as the back.

'The legs neither too long nor too short; the fore-legs straight from the breast to the foot, not bending inward at the knee, and standing far apart both before and behind; the hocks having a direction outwards, and the meeting of the thighs being particularly full; the bones fine, but having no appearance of weakness; and the legs of a speckled dark colour.

'The belly well defended with wool, and the wool coming down before and behind to the knee and to the hock; the wool short, close, curled, and free from spiry projecting hairs.

'The South Down is adapted to almost any situation in the midland part of England. It has a patience of occasional short keep, and an endurance of hard stocking, equal to any other sheep; an early maturity scarcely inferior to the Leicesters, and the flesh finely grained, and of good flavour.'

These sheep occupy the whole of the upper and under hill grounds of Sussex. Mr. Luccock calculated, that within a certain distance from the downs there were 864,000 sheep of this breed, a number which is only to be accounted for by the great quantity of artificial food that is raised on the arable part of every farm. It has often been attempted to introduce the Leicesters into the neighbourhood of the South Downs, but they could not be driven two or three miles twice every day from the pasture to the fold, and the fold to the pasture.

According to Mr. Ellman, the artificial food resorted to at the beginning of spring, and soon after lambing, is green rye; but it must be very cautiously given, on account of its occasionally producing diarrhœa or dysentery. This bad effect however may be prevented by removing the ewes once in the day to old pasture-ground.

The rye being fed off or running to seed, the ground is ploughed in May for turnips or rape. Rye-grass succeeds to the rye until the latter end of June, when the winter tares will come in, and which should be sown from the beginning of October to that of May, in order that one crop may follow another in proportion as it is wanted.

Tares, clover, or rape next take their turn; the tares perhaps are somewhat inferior to the others. As a winter food, the Swedish turnip comes in until lambing time; but not after that, lest it should produce purging in the lambs.

About the middle of October the rams are admitted to the ewes, and a plentiful allowance of nutritious and stimulating food will have considerable influence in increasing the number of lambs. Much to the credit of the breeder, great care is taken of the sheep during the lambing time. The ewes are either driven home, or there are sheltered places constructed in the fields.

The average dead-weight of the South Down wether varies from 8 to 11 stones; but at the Christmas show there are usually some pens in which the weight is double that. The average weight of the fleece used to be 2 lbs.; but from the altered system of management it is now at least 3 lbs. in the hill-sheep, and nearly 4 lbs. in the lowland-sheep. This wool has likewise changed its character. It has become a combing instead of a carding wool. Formerly devoted to the manufacture of servants' and army clothing, or being sparingly mixed with other wool, it is now used for flannels and baizes, and worsted goods of almost every description, thus becoming of considerably increased value. The hogget wool is particularly improved; it is finer than the other long wools, and is applicable to many new and valuable purposes.

The South Down sheep have succeeded admirably in all the southern districts of the kingdom; but the northern hills have occasionally been too cold for them. Crosses between the South Down and almost every breed of middle-wool sheep have answered well; while in counties where it could have been least expected, the old breed is in a great measure superseded by the South Downs.

In the adjoining county of Kent many South Downs are kept, and much prized; but in others, and on the marshes and their neighbourhood, they have given way to the Romney Marsh sheep.

The South Down differ materially in the different districts of Surrey. In some of the lofty and barren heaths a small and profitable sheep, distinguished by the name of The Bagshot, still prevails. The old Wiltshire sheep are occasionally seen here, while the Dorsets have possessed themselves of many extensive districts, and are employed in supplying the London market with early lambs. Still, however, the South Downs are numerous, and vie with any of the others in excellence and profit.

The old Berkshire breed is now rarely seen; the South Downs have usurped their place, and especially in the chalky districts. In Hampshire we can imagine that we recognize some of the old and valuable breed that supplied the Winchester manufactory. They are in a great measure the South Downs of the present day, or are very deeply crossed by them. The West Counties Down sheep is an importation from some of the western counties, particularly from Somersetshire; but it is gradually yielding to the South Downs.

The old Wiltshire breed of sheep, the largest and the heaviest of the fine-woolled sheep, has gradually passed away. They were crossed by the South Downs until every trace of the old breed had vanished, and a useful variety remained, which would have been called true Sussex sheep, only they were of a somewhat larger size and lighter colour, and a lighter finer fleece. This breed is now rapidly yielding to the true South Downs. In the lower-land pastures of Wilts a breed is found evidently derived from the South Downs, but larger in size, and with a heavier fleece.

We pass into Dorsetshire, and we find a very different and valuable breed of sheep. They are white; the face long and broad, with a tuft of wool on the forehead; the shoulders low but broad; the chest deep; the loins broad; and the bone small; a hardy and useful sheep. Their chief peculiarity is the forwardness of the ewes, which supply the market with lamb when it produces the highest price. If they have plenty of nutritious food, the ewes will be in lamb as early as April, so that the young one will drop in September, and be ready for the market at Christmas.

A very profitable variety is found in a cross between the South Down and the Dorset sheep. The carcase is increased, and the wool is rendered more valuable. The greater part of Dorsetshire is however occupied by the South Down sheep, and, on the whole, it is a far more profitable sheep than the pure Dorset.

Various breeds of short-wool sheep still prevail on the hills of Devonshire and Cornwall. They are evidently allied to or descended from the Dorset, although it must be confessed that the resemblance is not very flattering to the latter. The fleece is short, and mingled with too many kemps, but the mutton is supposed to possess a peculiarly delicate flavour, and great quantities of it are sent to the London market. They are much improved by a cross with the Leicesters. The South Downs have rarely succeeded in either county, except in the most cultivated parts. In Cornwall especially the varied and humid climate has been very unfavourable to them.

Returning through Somersetshire, we again meet with the South Downs, either pure or materially improving the native breeds. The Wiltshires and the Dorsets have also established themselves with advantage in many parts of the county. These breeds have even penetrated to the hills of Mendip, and the wild sheep of the district have nearly or quite disappeared. In Gloucestershire, except on the hills on the northern and eastern parts of the county, the short-woolled sheep, even those belonging to the Ryeland breed, have given way to the Cotswolds or the Leicesters. In Monmouthshire, with the exception of the small native breed on the hills, and a few flocks of South Downs which yet remain in different parts, the short-woolled breeds have materially diminished.

In Herefordshire we still meet with a few flocks of that breed of sheep which was in former times the pride of the agriculturist—the Ryelands. They are small, polled, with white faces, the wool growing close to and almost covering the eyes, the carcase round and compact, the animal quickly fattening, and the superabundant fat accumulating within. They are hardy, and peculiarly free from disease. They are particularly distinguished by the fineness of their wool. The number and the nature of the serrations place it precisely where the manufacture had long done. It is decidedly superior in fineness and in fullness to the South Down, but yields in both of these qualities to the Merino wool. It was attempted to cross the Ryeland sheep with the Merino, in order to increase the value of the wool. To a certain extent this was accomplished, but it was at the expense of the carcase. The Merinos were then crossed by the Ryelands, with a view to the improvement of form, and greater tendency to fatten, but this also failed. While these experiments were proceeding, arrived the period when the fleece of the short-woolled sheep, both the South Down and the Ryeland, was materially changed by the altered system of sheep-husbandry that was introduced, and the wool of both was rejected by the manufacturer for the purposes to which it had hitherto been applied. The author of 'Sheep,' published by the Society for the Diffusion of Useful Knowledge, states, that in the year 1500 Herefordshire contained 500,000 short-woolled sheep, furnishing 4,200 packs of wool, the weight of the fleece being 2 lbs. No long wool was then to be found in the county. In 1828 the number of packs of short wool had diminished to 2800, but no fewer than 5550 packs of long wool were grown, and the average weight of all the fleeces was 4 lbs. Such was the effect produced in the very territory and domicile of the finest-woolled sheep that England could produce. This fact speaks volumes as to the revolution that is going forward, and plainly points out the farmer's interest and duty.

Shropshire once contained several varieties of the short or middle woolled breeds of sheep, and among them were the old Shropshires, the Mountain sheep, the diminutive Shawberry, the Mynæ or Mouna sheep, and more particularly the Morfe Common, whose fleece was once scarcely equalled even by the Ryeland. It was the country of the short-wools, but now they have rapidly diminished, or almost disappeared before the Cotswolds and the Leicesters.

It is the same with the Cannock-heath breed in Staffordshire. Even the Tedderly breed has shared the same fate. Some few short-woolled sheep remain on the commons, and some valuable flocks of the South Downs are sparingly scattered over the country.

The Delamere sheep is the only short-woolled breed deserving of notice in Cheshire. The wool is short and fine, and still used by some manufacturers, but it is no longer used for any of the fine cloths.

The different districts of South Wales afford a small and valuable breed of sheep, principally used for the supply of the London market, where the Welsh mutton is in considerable request. These sheep seem scarcely to have changed their character for many centuries, but some crosses of the South Downs have been lately introduced, and even some flocks of this sheep have begun, and with much prospect of advantage, to spread over the lower part of the country.

In North Wales, and particularly in Anglesea, the old South Down re-appears, or a sheep whose likeness to the unimproved South Down is too striking to escape observation. The purest and best blood that the mountains of Wales are now supposed to be capable of producing is found at the foot or on the declivities of Cader Idris. All the hills of North Wales are covered with sheep, which are sent in the spring from all parts of the low country. The strongest wethers remain on the mountains during the winter, and without the slightest artificial provision for their support. The others are brought down to the low ground about Michaelmas to be returned in the spring.

Lancashire contains few sheep. The principal middle-woolled breed is the Woodland horned sheep, spreading from the Yorkshire side of the county to the very extremity of Scotland, intermingling with, and improving or deteriorating every other breed, and themselves indebted for their best qualities to the South Downs or the Leicesters. The short-woolled sheep of Westmoreland scarcely deserve notice, except as connected with the Herdwicks and the Cheviots. The former are of Scottish origin. They were brought by a ship from the north which was stranded on the coast of Cumberland. They were said to be small, active, polled, with speckled legs and face, of a finer fleece than the common black sheep, hardy, and defying any degree of cold. This peculiar quality was early noticed, and gave them a value which was not overrated. By degrees they spread over the mountainous districts, and other breeds were crossed by them on account of this valuable property.

At three or four years old they weigh 9 or 10 lbs. per quarter, and the wool is finer than that of the common black sheep.

The Cheviots extend from Westmoreland far into Scotland. Their birthplace, or where they were originally observed, and are still found in their greatest purity, is the Cheviot Hills, in Northumberland. They differ essentially from both the black and the dun faced breeds by which they are surrounded, but neither history nor tradition has given the slightest clue to their origin. The following is a description of the pure breed, thirty years ago, before they began to be crossed by the Leicesters :—“The head polled, bare and clean, with jaw-bone of a good length; ears not too short, and countenance of not too dark a colour; neck full, round, and not too long, well covered with wool, but without any coarse wool depending beneath; shoulders deep, full, and wide; chest full and open; chine long, but not too much so; straight, broad, and wide across the fillets; horns round and full; the body in general round and full, and not too deep or flat either in the ribs or flanks; the fleece fine, close, short, and thick-set, of a medium length of pile, without hairs at the bottom, and not curled on the shoulders, and with very little coarse wool on the hips, tail, or belly.”

Sir John Sinclair adds the following account of them :—“Perhaps there is no part of the whole island where, at first sight, a fine-woolled breed of sheep is less to be expected than among the Cheviot Hills. Many parts of the sheep-walks consist of nothing but peat-bogs and deep morasses. During winter the hills are covered with snow during two, three, or even four months, and they have an ample proportion of bad weather during the other seasons of the year, and yet a sheep is to be found that will thrive even in the wildest part of it. Their shape is excellent, and their fore-quarters in particular are distinguished by such justness of proportion, as to be equal in height to the hinder ones, which enables them to pass over bogs and snows through which a shorter legged animal could not penetrate. They have a closer fleece than the Tweeddale and Leicester breeds, which keeps them warmer in cold weather, and prevents either rain or snow from incommoding them. They are excellent snow-travellers, and are accustomed to procure their food by scraping the snow off the ground with their feet. They have never any other food but the grass and natural hay of their own fields, except when it is proposed to fatten them. They weigh from 12 to 18 lbs. per quarter, and their meat is fully equal to any that the Highlands can produce.”

The wool is inferior to that of the South Downs. It is not so fine as before the attempted improvement of the carcase, and the use of it is abandoned in the manufacture of fine cloth.

There are many flocks of pure Cheviots, but in the majority of the flocks there is a cross of Leicester blood.

The other breed of short-woolled sheep which contend with the Cheviots in number and value, is the *black-faced Scots.* They extend from Lancashire to the very north of Scotland. The males are mostly horned, the horns of a spiral form, but the females are frequently without horns. The faces and legs are always black or mottled: they are covered with wool about the forehead and lower jaw: the fleece is long and somewhat coarse. The carcase is peculiarly compact; so much so, that on account of the shortness, roundness, firmness, and handsomeness of the carcase, it is called the *short* sheep, in opposition to the Cheviots or *long* sheep. Great numbers of these sheep are sent to the London market. The weight of the carcase does not differ materially from that of the Cheviot, and the fleece weighs about three pounds after it is washed. These sheep have been improved by selection, but have derived little advantage from any of the crosses that have been tried.

As these are the prevailing breeds in the northern parts of the kingdom, if not to the exclusion of the short horns and the Leicesters, yet being far more numerous than they, it may not be uninteresting to institute a brief comparison of their respective merits. The three important points with respect to sheep in such localities are the weight and value of the wool, the carcase, and the degree of hardihood.

As to the wool there can be no question. The weight of the individual fleece may be somewhat, but not a great deal, in favour of the black-faced breed; but in point of value and the price which the wool will obtain, the advantage is most decidedly in favour of the Cheviots. As to the carcase, the Cheviot is ready for the market a full twelvemonth before the other. If so many sheep cannot be kept on the same quantity of ground, the quantity of meat that can be produced is greater, and consequently the profit of the farmer is greater; and as to hardihood, they are both of them excellent breeds, and it might be difficult to decide which wool would most successfully endure the hardships of a Highland winter. The adjudication on the whole is most decidedly in favour of the Cheviot breed, with this exception perhaps, that on the wildest of the Grampian or other similar hills the black-faced mountain sheep may have the best chance of doing well; and the acknowledged fact is, that in almost every northern district the Cheviots are rapidly superseding the native black-faced sheep.

One other breed of short-woolled sheep must be mentioned before we return to the southern parts of the kingdom—those which inhabit the Shetland Islands. They frequently weigh not more than seven or eight pounds a quarter, and yield from one and a half to two pounds of fine and soft wool, either of a white, or grey, or even black colour. It is the finest wool which Great Britain can produce, and is used for the better sort of stockings, and for several light and extensive manufactures.

In Northumberland the *mugg* sheep, so called from their faces being completely covered with wool, have disappeared. In Durham there are few besides long-woolled sheep. The eastern and western moorlands of Yorkshire contain many short-woolled sheep—the Cheviots, the black-faced Scots, the South Downs, and some flocks peculiar to the moorlands, as the Penistone sheep with mottled or coloured faces and legs. In Lincolnshire some flocks of true South Down sheep are still to be found, in the northern and western districts, but the greater part of them have mingled with or given way to the long-woolled sheep. The beautiful little sheep on Shirwood Forest, not yielding more than eight or nine pounds to the quarter, and the delicate fleece which covered them, have passed away. In Derbyshire, Leicester, Rutland, Warwick, Northampton, Huntingdon, Cambridge, Bedford, Hertford, Buckingham, and Oxford, some flocks of the middle-woolled sheep are to be found, and many valuable crosses between the South Downs and the Norfolks, but on the whole the short-woolled sheep have declined.

Norfolk and Suffolk used to possess their peculiar breeds, with the face long and thin, flat on the forehead, and flattened at the muzzle, the legs long, the face and legs mottled, or liked the more if they are of a pure black, the fore-quarters deficient, the hind ones sufficiently developed; fattening readily at two years old; bearing without fatigue a journey to a distant fold, and therefore of great value to the farmer in rendering many a plot of land productive by occasionally affording almost the only manure that could be obtained. These, together with the disposition to feed even on the coarsest pastures, were qualities which rendered the Norfolks great favourites in their own country. Presently, however, came the comparison with the modern South Downs, who were remarkable for their quiet and contented disposition, compared with the wild and restless character of the Norfolks; the smaller quantity of food which they were thus enabled to consume in proportion to their size; the superior weight which they acquired in proportion to the food which they consumed; the greater quantity of wool which they yielded; the superior quality of that wool; the greater number of lambs that were produced; the tender and more attentive nursing of these lambs; all these circumstances united to prove the superiority of the South Downs. It was attempted to cross the rival breeds, and the experiment was attended by evident advantage to the Norfolks; but by degrees the pure breed was valued as it deserved to be, and the breed of the old Norfolks evidently and extensively diminished.

Most of the Norfolk flocks have now been crossed by the South Downs or the Leicesters. The animal has, in consequence of this, increased in size and in early perfection, and weight of fleece; and that fleece, more useful for many purposes, is almost doubled in value. Lord Western has obtained a cross of the South Down and Hampshire, omitting entirely the Norfolk, and with apparent advantage.

We now arrive at the *Long-Woolled Sheep*. Their early history is obscure; but in the twelfth century there are accounts of exportations of wool and of sheep, evidently belonging to the long-woolled variety, as appears from the manufactures in which these fleeces were employed. In the thirteenth century, certain Florentine merchants were permitted to export to Flanders more than a thousand sacks of combing or long wool. In the fourteenth century the thousand had extended to a hundred thousand, and that continued during many years; and in the fifteenth century Edward IV. permitted his sister Margaret to export annually during her life 2000 rams to Flanders and Holland. This well explains the resemblance between the sheep on the two shores; and the traveller will cease to wonder that on the northern coast of France, and through nearly the whole of Flanders, he fancies that he recognizes the identical sheep of the Kentish pastures. In the same century, a royal present of Cotswold wool was sent to the king of Portugal.

There is much more similarity between the varieties of the long-woolled sheep than those of shorter fibre. The deficiency of horns, the form of the head, the expression of the countenance, and the white faces and legs, show that they had one common origin; while the colour and weight and uses of the wool speak their common origin.

The following description of the *new Leicester* by Mr. Culley will, to a very considerable degree, serve for all the varieties of the long-woolled sheep. The head should be hornless, long, small, tapering towards the muzzle, and projecting horizontally forwards. The eyes prominent, but with a quiet expression. The ears thin, rather long, and directed backwards: the neck full and broad at its base, but gradually tapering towards the head, and particularly fine at the junction of the head and neck. The neck seeming to project straight from the chest, so that there is, with the slightest possible deviation, one continued horizontal line from the rump to the poll. The breast broad and full; the shoulders also broad and round, and no uneven or angular formation where the shoulders join either the neck or the back, particularly no rising of the withers, or hollow behind the situation of those bones. The arm fleshy through its whole extent, and even down to the knee. The bones of the legs small, standing wide apart, no looseness of the skin about them, and comparatively bare of wool. The chest and barrel are at once deep and round in the ribs, forming a considerable arch from the spine, so as in some cases, and especially when the animal is in good condition, to make the apparent width of the chest even greater than the depth. The barrel ribbed well home. No irregularities of line on the back or the belly; but on the sides the carcase very gradually diminishing in width towards the rump. The quarters long and full, and as wide as the fore-legs. The muscles extending down to the back, the thighs also wide and full. The legs of a moderate length; the pelt also moderately thin, but soft and elastic, and covered with a good quantity of white wool, not so long as in some breeds, but considerably finer.

Such is the Leicester sheep as Bakewell made him. He found him as different an animal as it was possible to conceive —flat-sided, large-boned, coarse-woolled, slow to fatten, and his flesh of little value. Were there room for its insertion, a detailed history of the different steps of the changes would be most interesting to the reader. The means were simple, and the effect was almost magical. The principle was, that 'like produces like;' and therefore he selected a few sheep with aptitude to fatten, with a disposition to produce an unusual quantity of valuable meat, with little bone and offal, and with quietness of temper; and from these he exclusively bred. He cared not about near or distant affinities, but his object was to increase every good point, and gradually to get rid of every bad one. They were not different sorts of sheep that he selected, but the best of the breed to which he had been accustomed.

His sheep were smaller than those of his neighbours, but they retained every good point, and had got rid only of the bad ones. The alteration was rapid as well as great in his own flock, and the practice which he introduced of *letting* some of his rams quickly extended the benefit of his system far and wide. The first ram which he let was in the year 1760, at 17*s.* 6*d.* for the season. In 1789, he let one ram for 1000 guineas, and he cleared more than 6000 guineas in the same year by the letting of others. After that, so great was the mania, or rather the desire for improvement, that Mr. Lawrence calculates that 100,000*l.* were annually spent by the midland farmers in the hiring of rams.

Such was the origin and the eventual triumph of the new Leicester breed of sheep. They have spread themselves to every part of the United Kingdom. There are few other varieties of long-woolled sheep which do not owe much of their excellence to the new Leicesters, and even some of the short-woolled flocks are deeply indebted to the breed introduced by Bakewell. There is no other species of sheep that possesses so decided a propensity to fatten—or that is prepared for the butcher at so early an age. It will not, however, thrive on a poor soil, nor if it is compelled to travel far in order to procure its food; but on soils of a moderate quality there is no other sheep so profitable. Other breeds, as the Teeswater and the Lincoln, may be superior in size, but it is at an expense of time and of food, and eventually a palpable deterioration of flesh and diminution of profit. The new Leicesters on fair keep will yield a greater quantity of meat, for the same quantity of food, than any other breed of sheep. The meat is of a peculiar character. It is disliked by some on account of a supposed insipidness. The fatty matter is too much introduced between the muscular fibres, and there may be the appearance and the taste of a mass of luscious fat. This however is the fault of the breeder, and not of the animal: it marks the point to which the fattening process should be carried, and where it should stop. It is the fault of the grazier if he converts that which is an excellence into a fault.

There are accounts of the Leicester sheep attaining a very great weight. Two prime wethers exhibited by Mr. Painter at the Smithfield cattle-show in 1835, weighed 165 and 155 lbs. It should however be remarked that the new Leicester sheep has a smaller quantity of bone in proportion to its weight than any other sheep.

The deficiency of the fleece was formerly objected to in the new Leicester sheep. The truth of the matter was that, with the early breeders, the fleece was a perfectly secondary consideration, and comparatively disregarded. There is now little cause for complaint on this head. The wool has considerably increased in length, and it has improved both in fineness and strength of fibre. It averages from 6 to 7 lbs. the fleece, and the fibre varies from five to more than twelve inches in length. Like all other British wools, it is applied to a purpose different from that to which it was formerly devoted, and is mostly used in the manufacture of serges and carpets.

The chief value of the new Leicester breed consists in the improvement which it has effected in almost every variety of sheep with which it has been crossed. Most of the breeders of the South Downs were at first averse to admit a cross with the Leicesters; but when the wool of the South Downs began to be applied to purposes very different from those to which it had been formerly devoted, a cross with the Leicesters was reluctantly attempted. A sheep was produced, probably not so hardy, but coming earlier to the market, yielding a longer and a finer fleece, of nearly double the weight and with a combing wool adapted for many valuable purposes.

Many of the Dartmoor and Exmoor sheep have obtained earlier maturity, an increased size, and a more valuable fleece by a cross with the Leicesters. In Somersetshire the Bampton sheep have decidedly increased in value by a cross with the Leicesters. The Ryelands, now that their wool is no longer employed in the manufacture of fine cloth, have materially profited by crosses with the Leicesters: the profit from the carcase is increased, and the wool has a readier sale. In Worcestershire and Staffordshire the advantage of a cross with the Leicesters is acknowledged by every one who has ventured to make the experiment. In South and in North Wales they have found powerful antagonists in the Cotswolds; but in Lancashire, in Westmoreland, and in Cumberland, the native short-woolled sheep have been crossed by the Leicesters with considerable benefit.

In Northumberland the black-faced

sheep are numerous, and it is the native country of the Cheviots; but the valleys and plains, and these are numerous and fertile, will bear the larger Leicester breed. Some attempts have been made in Northumberland to cross the Leicester breed with the large and coarse rams of Teeswater or old Lincolnshire breeds, but the experiment has almost uniformly failed, for the produce has had inferior wool and inferior flesh, and has been defective in form and slower in growth, with a much lighter carcase.

It is however difficult to select any part of the kingdom into which the Leicester and the South Down sheep have not penetrated, and where they have not materially improved the native breed. The weight both of the sheep and of the fleece have been increased, and the farmer actually derives a better remuneration from his flock than when the wool was short and fine and of little weight, although it obtained a better price.

A short account must be given of the other breeds of long-woolled sheep, although some of them are rapidly passing away. The Teeswater, inhabiting the southern districts of Durham and the north of Yorkshire, was once in considerable request on account of the weight of its carcase, the goodness of its flesh, and the remarkable degree in which the ewes were prolific. Its greatest fault was that it was too heavy for the lowlands in which it was placed, and the pasture was trodden down and destroyed. Some of the Leicesters found their way to the banks of the Tees, and the old breed was crossed by them. The carcase became somewhat smaller, but it was more compact and profitable. More mutton was produced on the same quantity of land; and, after a considerable time, for the improvement was always slower with regard to the wool than the flesh, the fleece became finer and closer. The old breed of this and the neighbouring counties gradually diminished and almost disappeared.

The largest and most ungainly breed of sheep was the Lincolns, 'hornless, with long, thin, and weak carcases, large bones weighing from 20 to 30 lbs. a quarter; the wool averaging from 8 to 14 lbs. the fleece; the sheep a slow feeder, and the flesh coarse-grained.' This is the account given of them by a good, but a prejudiced observer, Mr. Culley. In fact, while Bakewell and his admirers were almost neglecting the fleece, the Lincolnshire farmer was quite as inattentive with regard to the carcase. Both parties were wrong. The old Lincolnshire sheep yielded a wool which in quantity and in quality was unrivalled, while the Leicesters could boast of a disposition to fatten which the other could never equal. At length the attempt was honestly made to amalgamate the valuable qualities of the two breeds. In consequence of the cross, the wether attained its maturity a full year sooner than it was accustomed to do, and the fleece became finer and improved in colour, but it was shorter and more brittle, and not fitted for some of its former purposes. On the whole, a great improvement has been effected both in the carcase and the fleece, and so satisfactory did this prove, that it is now difficult to find any sheep in Lincolnshire that have not been crossed with the Leicesters. This cross is deeper on the wolds than in the marsh lands, which may serve to account for the difference of the fleece in the two. The breed of these sheep generally has been greatly increased since the introduction of the turnip system.

Among the long-woolled sheep that have been improved by the admixture of the old and new long-woolled breeds and the altered system of husbandry, the inhabitants of Romney Marsh must not be forgotten. From time immemorial a peculiar and highly valuable breed was cultivated there. The produce in wool and the thickness in stocking were scarcely equalled in any other breed or situation. The Kentish men obstinately resisted every encroachment on their favourite breed, and predicted disappointment and loss in every possible form. 'For a while,' says the author of the work on Sheep already referred to, 'it seemed as if they had reason on their side, for the size of the sheep was considerably lessened, and the wool was not so valuable, nor yielded in its former quantity. By degrees however it began to be found that these smaller, deeper, closer, and more compact sheep weighed heavier than the old long-legged and longbodied ones; that they did not consume so much food, that the hard stocking of former days might be increased, that they were ready a full year sooner for the market, and therefore became far more profitable. That the fat formed more on the exterior of the animal, where it was advantageously placed for the farmer and the consumer, and did not accumulate within for the profit of the butcher alone: and that, by careful selection, although the wool was somewhat shorter and lighter, it was improved in firmness and colour and felting property.'

Some valuable breeds of long-woolled sheep are found in the South Hams in Devonshire, extending from Axminster to Dartmoor, and from the north of Devon to the vale of Taunton, under the name of the Bampton sheep, and also, but smaller in number and size, in the neighbourhood of Exmoor.

The Cotswold sheep, so called from the cots or sheds in which they were housed, formerly inhabited the counties of Gloucester, Hereford, and Worcester. They were a long-woolled breed, yielding in the fifteenth century a description of wool much valued on account of the fabrics in the construction of which it was employed. Both the sheep and the wool were largely exported. Even they, like the rest, have amalgamated themselves with and been in a manner lost among the Leicesters. They were taller than the present sheep, flat-sided, deficient in the fore-quarter, but full in the hind-quarter, not fattening so early, but yielding a long and heavy fleece. Many of these good qualities have been preserved, and to them have been added that which is of so much importance to the farmer, the capability of rearing and fattening so many more sheep on the same quantity of land, and of bringing them so much earlier to the market.

The *Irish* sheep, like those in Great Britain, are divided into the short and long woolled breeds. The *short-woolled* are most numerous in the mountains of Wicklow. The head is small and bare: the general proportions good if there were somewhat more substance; the legs small and clean; the fleece coarse and wavy, or occasionally matted, and yielding a fleece of from 2 to 3 lbs., which is appropriated chiefly to the manufacture of flannel. Many of the flocks have with much advantage been crossed with the South Downs, in defiance of the prejudice and jealousy of a proportion of the Irish farmers. The progenitors of the *Irish long-woolled sheep* seem to have been as ill-bred and as unprofitable as the worst of the class in England; but the Leicester breed has found its way to Ireland; it struggled for a while against prejudices and difficulties of every description, and at length has completely triumphed. The Irish sheep which are now brought so plentifully to the English market will scarcely yield to the best improved Leicesters that any part of Great Britain can produce.

The English wool being, from the increased coarseness of the fibre, rejected by the manufacturer in the construction of fine cloths, recourse was had to foreign wools, and to those chiefly that were derived from the Merino sheep. As early as the commencement of the Christian æra, the wool of the Spanish sheep was in great request for the production of the most costly dresses. In less than half a century afterwards we find Columella busily employed in improving the Spanish sheep, and the effect of his labours remained during the long dark ages that succeeded. The Merino flocks withstood the baneful influence of almost total neglect, and continued, to a greater or less degree, to furnish the finest and the choicest wool.

By degrees the Merino sheep found its way to almost every part of the European continent, and by careful management its fleece rapidly increased in fineness and in usefulness. In 1834, the prime wool produced in Spain readily found a sale at from 3*s.* 6*d.* to 4*s.* per lb. In Saxony it reached to 5*s.* 3*d.* per lb., and in some parts of Hungary to 5*s.* 6*d.* In Australia the cultivation of the Merino sheep and its fleece has proceeded most rapidly and prosperously. The best of its wool when it reached England was sold at 4*s.* 6*d.* per lb. That from Van Diemen's Land was not half so highly estimated, but it has since improved. The wool of our primest South Down hoggets would at that time rarely produce more than 2*s.* 2*d.*, and yet the farmer was better off, for he obtained an earlier and a better and a larger carcase, and a greater quantity of wool.

Our notice of the sheep in other countries must be exceedingly brief. Along the western coast of France the traveller continually meets with the semblance of those noble animals which Edward IV. permitted to be annually sent to improve the breed of foreign sheep on the other side of the Channel. The wool is now about the same in value as that of our inferior Lincoln or Kentish. In Normandy is a larger and a coarser variety of the same breed. In the old province of Maine succeeds the old unimproved, long, and thin-carcased native French breed. In Bretagne and Gascony will be recognised the native short-wools, some of them exceedingly valuable; in Navarre, a mountain breed, with its *kempy* fleece; in the Lower and the Higher Pyrenees, the two essentially different breeds which countries so different yet so near to each other produce. On entering Rousillon some migratory breeds scarcely inferior to the Merinos are found, and also in Languedoc and Arles. The whole number of sheep in France is calculated at about 30,000,000.

Notwithstanding the accounts given by some authors of the *Italian* sheep and of the care bestowed on them, there are few deserving of notice except a few Merinos. With the exception of a few of the valleys the same may be said of the *Swiss*, and also of the *Savoy* sheep, but in *Piedmont* there has been from time immemorial a breed of sheep inferior only to the Merinos. In most of the *German States* the Merino is almost the only sheep that is cultivated. It is the same in Prussia, except that the sheep are somewhat diminished in size, while the wool retains all its value. The chief wealth of *Hungary* is derived from the cultivation of the Merino sheep. Of the two *Hanoverian* breeds the larger one has almost disappeared; the smaller has been crossed with the Merinos and yields a wool of some value for ordinary purposes. The *Dutch* and *Flemish* breeds are of English origin, although some of them have considerable resemblance to the Irish long-woolled breed. Their wool is used for the production of the coarser kinds of goods.

This will be the proper place to speak of the *shearing* of the sheep, or the separation of the fleece from the animal. The time for this operation will vary much with the state of the animal, and of the season. After a cold winter, and the animal having been neglected, the sheep will be ready at an early period, for the old coat will be loosened and easily removed. The operation should never be commenced until the old wool has separated from the skin, and a new coat of wool is sprouting up. The coldness or warmth of the spring will also make a great difference. The usual time for shearing is about the middle of June, and the sheep-master will in a moment perceive when the fitting time is come. It is a bad practice to delay the shearing, for the old fleece will probably have separated, and the fly will have longer time to do mischief, and the growth of the new fleece will have been stinted, or a portion of it will be cut away by the shears.

Custom has very properly required that the old fleece shall be cleansed before its removal, by washing the animal in some running stream. Two or three days are then allowed for the drying of the wool previous to its being shorn, the sheep being turned into a clean rick-yard, or field or dry pasture, and remaining there until the fleece is dried, and that the new yolk, which is rapidly secreted, may penetrate through it, giving it a little additional weight and a peculiar softness. As soon as the sheep is shorn, the mark of the owner is placed upon it, consisting of lamp-black and tallow, with a small portion of tar, melted together. This will not be washed away by any rain, but may be removed by the application of soap and water.

On the score of humanity, one custom must be decidedly protested against—the shearing of a flock of sheep before they are driven to the market in an early part of the spring. The farmer thinks that he shall get nearly or quite the same price for the sheep whether the wool is off or on. But does he find this to be the case? When the poor animals are shivering under the influence of the cold air, do they look so attractive? Do they handle well? Is there not an appearance of disease about them? Does not the rheum that hangs about the nostrils indicate the actual commencement of disease?

Few rules can be laid down with regard to the rearing and feeding of sheep that will admit of anything like general application. A great deal depends on the kind of sheep, and the nature of the pasture and the food.

Suppose the larger kind of sheep, and on arable ground. The ewes are generally ready to receive the ram at the beginning of October, and the duration of pregnancy is from about twenty-one to twenty-three weeks, bringing the period of parturition to nearly the beginning of March, at which time most of the lambs will be dropped. The ewes should be fed rather better than usual a short time previous to the male being introduced. Rams are fit to propagate their species in the autumn of the second year, and that is also the proper period for the impregnation of the ewes. The ewe is, after impregnation, suffered to graze on the usual pasture, being supplied, as occasion may require, with extra food, and especially in cases of snow, until within five or six weeks of lambing, when turnips are given to her, and continued from that time until the spring of grass renders them no longer necessary. The turnips are laid out for the ewes in the grass fields in certain quantities each day, but by no means so many as they would consume if permitted to feed without restriction, as it is considered to be most important that they should not be too fat when the lambing season approaches. The hogs and the fattening sheep of the previous year, now one year and a half old, are put upon the turnips in October, or whenever the pastures cease to improve their condition. The turnips required for the cattle, or the ewe-flock, are then drawn off in alternate rows, in the proportion of one-half, one-third, or one-fourth, as the convenience of the situation, the goodness of the crop, or the quality of the land may dictate. The remainder are consumed on the ground by the other sheep.

As the period of parturition approaches, the attention of the shepherd should increase. There should be no *dogging* then, but the ewes should be driven to some sheltered inclosure, and there left as much as possible undisturbed. Should abortion take place with regard to any of them, although it does not spread through the flock as in cattle, yet the ewe should be immediately removed to another inclosure, and small doses of Epsom salts with gentian and ginger administered to her, no great quantity of nutritive food being allowed.

The ewes should now be moved as near home as convenience will permit, in order that they may be under the immediate observation of the lamber. The operation of *clatting*, or the removal of the hair from under the tail and around the udder, should be effected on every long-woolled ewe, otherwise the lamb may be prevented from sucking by means of the dirt which often accumulates there, and the lamber may not be able at all times to ascertain what ewes have actually lambed. The clatting before the approach of winter is both a useless, cruel, and dangerous operation.

The period of lambing having actually commenced, the shepherd must be on the alert, yet not unnecessarily worrying or disturbing the ewes. The process of nature should be permitted quietly to take its course, unless the sufferings of the mother are unusually great, or the progress of the labour has been arrested during several hours, or eighteen or twenty hours or more have passed since the labour commenced. His own experience, or the tuition of his elders, will teach him the course which he must pursue. In the work on 'Sheep' these things are fully explained.

If any of the newly dropped lambs are weak, or scarcely able to stand, he must give them a little of the milk, which at these times he should always carry about him, or he must place them in some sheltered warm place; in the course of a little while, the young one will probably be able to join its dam. The lambing field often presents at this period a strange spectacle. 'Some of the younger ewes, in the pain and confusion and fright of their first parturition, abandon their lambs. Many of them, when the udder begins to fill, will search out their offspring with unerring precision; others will search in vain for it in every part of the field with incessant and piteous bleating; others again will hang over their dead offspring, from which nothing can separate them; while a few, strangely forgetting that they are mothers, will graze unconcernedly with the rest of the flock.'

The shepherd will often have not a little to do in order to reconcile some of the mothers to their twin offspring. The ewe will occasionally refuse to acknowledge one of the lambs. The shepherd will have to reconcile the little one to its unnatural parent, or to find a better mother for it. If the mothers obstinately refuse to do their duty, they must be folded by themselves until they are better disposed; and on the other hand, if the little one is weak and perverse, he must be repeatedly forced to swallow a portion of her milk until he acknowledges the food which nature designed for him.

The operation of castration should be performed nine or ten days after the birth of the lamb; that of spaying, if it is intended to be practised, should be postponed until the animal is about six weeks old.

Unless the pasture on which the ewes are placed is very good, it will be advisable to continue the use of the turnips. A moderate quantity may be given twice in the day, care being taken that the whole of one quantity shall be eaten before any more is placed before them. This is a better practice than hurdling off certain portions of the field for the sheep, unless the land is perfectly dry.

A little hay will always be serviceable while the flock is fed on turnips. It corrects the occasional watery quality of the turnips, and the sheep usually thrive better than if they are fed either on hay or turnips alone. Bran and oats, with oilcake, have been recommended for the ewes before weaning time, but this is an expensive measure, and its cost can hardly be repaid either by the ewe or the lamb.

By the end of March or the beginning of April the turnips are generally nearly consumed, and the farmer is occasionally a little puzzled to find sufficient food for his flock. He should have had some plots of rye to support them for a while. Ryegrass and clover are very serviceable. Swedish turnips that have been carefully stacked on dry straw will be most useful, for the Swedes, properly prepared and stacked, will retain their nutritive quality until the flock can be conveniently supplied with other food. Rutabaga and burnet are always useful for spring food. The good qualities of the latter are not sufficiently estimated. It will generally be ready by the middle of February if required. The rowen, or after-grass, likewise furnishes plentiful and wholesome food for the lambs.

At length comes the time for weaning. In a poor country it takes place before the lambs are much more than three months old. In a more plentiful one the lambs may be left until the fourth month is nearly or quite expired. If the pasture is good, and it is intended to sell the lambs in store condition, the weaning may be delayed until six months. Whichever time is selected, it is of essential consequence that the mothers and the dams should be placed so far apart that they cannot hear the bleatings of each other. The ewes should be somewhat carefully looked after, and if any of them refuse to eat, they should be caught, the state of the udder ascertained, and proper measures adopted.

The lambs should not be put on too stimulating food. The pasture should be fresh and sweet, but not luxuriant. It should be sufficient to maintain and somewhat increase their condition, but not to produce any dangerous determination of blood to any part.

The Diseases of Sheep.—The rapid progress which the veterinary art has lately made, has thrown great light on the maladies to which the sheep is liable, and the mode of preventing or removing them.

Commencing with the muzzle and head, there is a disease, or rather annoyance, to which sheep are exposed by the persecution of a fly, the *Œstrus Ovis*, or *Gadfly* of the sheep. At some uncertain period between May and July, this fly is perseveringly endeavouring to lay its eggs on the inner margin of the nostril of the sheep, whence, hatched by the warmth and moisture of the situation, and assuming its larva form, it crawls into the nostril in order to reach the frontal sinus. Instinctively alarmed by the buzzing of the fly, or the motions of the larvæ, the sheep congregate with their heads in the centre, pawing continually with their feet, and expressing their dislike and fear in every possible way. It remains in the sinus a certain period, until it has attained its full growth, when it endeavours to escape in order to undergo another transformation. It escapes from the nostril, burrows in the earth for a while, assumes its pupa state, undergoes its final change, and assumes the form of a fly, and then becoming impregnated, seeks again the nostril of the sheep. All that can be done with regard to this nuisance is to destroy the flies, which are generally to be seen on the walls or pales in the neighbourhood of the flock, and which the shepherd, or shepherd's boy, should be taught to recognise.

Another parasite is a species of hydatid, the *Cœnurus* or *Hydatis polycephalus cerebralis.* It has the appearance of a bladder sometimes filled with pellucid water, or, occasionally, with myriads of minute worms, or smaller hydatids. Its residence is the brain, either beneath the inner membrane of the brain, or in the scissure between its two hemispheres. The origin of it is not clear, except that it is connected with bad management, being scarcely known in upland pastures or in grounds that have been well drained. As the parasite grows, it presses upon the neighbouring substance of the brain, and interferes with the discharge of its functions. There is an aberration of intellect; the sheep is frightened at any trifling or imaginary object; he separates himself from his companions; he commences a strange rotatory motion even while he grazes, with the head always turned towards the same side. This is the characteristic symptom, and as soon as it is perceived the animal should be destroyed, for there is no certain cure, and many of the operations that some persons have described are cruel and inefficient. The duty of the farmer is to destroy the *sturdied sheep* as soon as the disease is ascertained, however poor it may be in condition.

A somewhat similar disease, but with which the hydatid has nothing to do, is *Hydrocephalus*, or *water in the head,* generally indicated by a little enlargement of the skull; a disinclination to move; a slight staggering in the walk; a stupidity of look, and a rapid loss of condition. This disease seldom admits of cure or palliation. If any amendment can be effected, it will be by the administration of good food, tonic medicine, and gentle aperients. When water in the head is an occasional visitant in a stock of sheep, there is something wrong in the land, or its management, or in the nature of the food, or the character of the sheep.

Another species of pressure on the brain is of too frequent occurrence—*Apoplexy.* A flock of sheep shall be in apparently as good and fine condition as the farmer can desire. They have for a considerable period grazed on the most luxuriant pasture, and are apparently in the highest state of health. By and bye, one or more of them is, without any previously observed change, suddenly taken ill. He staggers, is unconscious, falls and dies, and perhaps within a quarter of an hour from the first attack. With regard to how many overfattened sheep is this the case? The owners taking them to some cattle-show, say that they died of inflammation. Inflammation had nothing to do with it. The sheep had been brought to the highest and most dangerous state of condition. Every vessel was overloaded with blood, and then some trifling exertion being required, or the animal being a little disturbed, the nervous functions were suspended, and the vital current suddenly arrested. Very few persons have gone into a cattle-show without being painfully struck with the evident distress exhibited by some of the overgorged animals.

If there is time for resorting to curative means, the jugular vein should be opened, and aperient medicine administered.

Inflammation of the Brain is a frequent consequence of this strange over-feeding. It is ushered in by dullness and disinclination to move: but presently the eye brightens, and the animal attacks everything within his reach. If it can be managed, the same treatment must be adopted —bleeding, physic, and low feeding.

Locked-Jaw is not an unfrequent disease among sheep. It commences with an involuntary spasmodic motion of the head, accompanied by grinding of the teeth, but the latter symptom is presently succeeded by fixedness of the jaws. The disease often runs its course in a little more than twelve hours. The principal cause is cold and wet. After an unusually cold night, it is not uncommon to find many ewes that have lately lambed, and many lambs recently dropped, dead and stiffened. It sometimes occurs after castration, and at weaning time. Bleeding, aperient medicine, an opiate given an hour after the physic, and also a warm bath, are among the most likely means of cure.

Epilepsy is a not unfrequent disease among young sheep which are exposed too much to cold or dismissed from the fold too soon in the morning. Care and nursing will sometimes recover them, or a little exercise forced upon the patient.

Palsy.—The appearance of this disease is mostly confined to the ewe and lamb at weaning time, or when they are left at night in a bleak and exposed situation. The vital heat is abstracted by the cold bed on which they lie, and the cold air around them, and there follows a compound of rheumatism and palsy, the latter predominant and most obstinate. In the majority of cases they will never regain their former condition or value, but continue a disgraceful exhibition of the carelessness and inhumanity of the owner. It is dreadful to think how many animals in some districts are thus destroyed. No little art and kind treatment are in some cases requisite in order to recover these neglected and abused creatures. Warm gruel or milk, and a moderate degree of warmth, are the chief restoratives that can at first with safety be applied. A little ginger and spirit of nitrous æther may be added to the gruel when the patient begins to recover.

Rabies.—The rabid dog seems to have an irresistible propensity to worry sheep, and the poison is as fatal in this as in any other animal. There are cases on record in which from twenty to thirty have been bitten by the same dog, and all have died. If it can be proved that the flock has been attacked by a mad dog, every sheep should be most carefully examined, and if the slightest wound is found upon him, he should be destroyed. The carcase is not injured for the butcher, nor is there at that time any danger in eating the flesh; but when the disease has broken out in the flock, no sheep that has exhibited the slightest trace of it should be used for human food.

There is no cure for rabies, and he will incur fruitless expense who has recourse to any pretended nostrum for this purpose.

Ophthalmia is a very frequent disease among sheep. The old people used to say that the animal had disturbed a lark's nest, and that the lark had spurred him blind. If any inflammation of the eye is detected, that organ should be frequently bathed with a weak solution of Gowland's lotion, to which a few drops of laudanum have been added. It is sometimes difficult to get rid of this affection, and cataract and permanent blindness will ensue. The Ettrick shepherd says that " a friend will generally attach itself to the sufferer, waiting on it with the most tender assiduity, and by its bleating calling it from danger and from going astray."

Hoove is a morbid distension of the paunch with food, and the extrication of gas from that food. An account has been given of this disorder in the article Ox, so that every purpose will be answered by referring to it. The same may be said of all the diseases of the digestive organs. Their structure is the same in cattle and in sheep; and the causes and appearances and treatment of the diseases are the same.

There is however a disease of the liver —*the Rot*—far more frequently occurring in sheep than in cattle, and bearing a peculiar and more destructive character.

In the very earliest stage alone does it admit of cure. The decisive symptom, at that time, is a yellow colour of the eye that surrounds the pupil and the small veins of it, and particularly the corner of the eye, which is filled with a yellow serous fluid, and not with blood. There is no other apparent morbid appearance until it is too late to struggle with the malady; on the contrary, the sheep, although perhaps a little duller than usual, has an evident propensity to fatten.

The rot is a disease of the liver—inflammation of that organ; and the vessels of it contain fasciolæ (*flukes*). The flakes are probably more the effect than the cause of the disease. They are taken up in the food; they find their way to the liver as their destined residence, and they aggravate the disease by perpetuating a state of irritability and disorganization. The rot is evidently connected with the state of the pasture. It is confined either to wet seasons or to the feeding on ground that is moist and marshy. In the same farm there are fields on which no sheep can be turned without getting the rot, and there are others that never give the rot. After long continued rains it is almost sure to appear. The disease may be communicated with extraordinary rapidity. A flock of sheep was halted by the side of a pond for the purpose of drinking; the time which they remained there was not more than a quarter of an hour, yet two hundred of them eventually died rotten. In the treatment of the rot little that is satisfactory can be done. Some sheep have recovered, but the decided majority perish in despite of every effort. The patients however may, as giving them a little chance, be moved to the driest and soundest pastures; they may undergo a regular course of aperient medicine. Mercurial friction may also be used, but, above all, plenty of salt should be placed within the animal's reach, and given to them in the way of medicine.

In the way of prevention the farmer may do much: he may drain the most suspicious parts of his farm. No money would be more profitably expended than in accomplishing this. Some of the little swampy spots which disgrace the appearance of his farm possibly lie at the root of the evil.

Red-water, or the effusion of a bloody serous fluid in the cavity of the abdomen, is a frequent and very fatal disease among sheep. The cause of it is a sudden change from one pasture to another of almost opposite quality, or the moving of the flock from a dry and warm to a damp and cold situation. It is most destructive to lambs if exposed to a hard frost or suffered to lie on a damp and cold soil. The sheep will separate himself from the rest of the flock; he will evince a great deal of pain, by rolling about and frequently lying down, and immediately getting up again; and sometimes he dies in less than twenty-four hours from the first attack. The belly will be found swelled and filled with the red water, or serous fluid tinged with blood, from which the disease derives its name. The treatment should consist of mild aperients, with gentian and ginger, and a liberal allowance of hay and corn. Inflammation of the coats of the intestines (*Enteritis*) would not always be readily distinguished from the last disease, except that there is more stamping on the ground and striking the belly with the hind legs, and occasional lying on the back. The principal causes of enteritis are improper food, or an excess of that which is healthful, or exposure to cold and wet. Here also bleeding is imperatively required, but the purgative should not consist of anything stronger than sulphur. *Diarrhœa* is a very prevalent disease among lambs, and especially after a change of diet or of situation. When it is not violent, and does not seem to be attended by colic, a little absorbent and astringent medicine, with a few grains of opium, may be administered. The diarrhœa of sheep may be similarly treated, but when the disease is assuming the character of *dysentery* — when the discharge is more frequent and copious, and mingled with mucus, a larger quantity of this medicine should be given, and some blood abstracted if there is any degree of fever.

The diseases of the *respiratory organs* are often of a serious character. During the greater part of the winter the nostrils will sometimes be filled with mucus, and the sheep is compelled to stop for a moment at every second or third bite, and snort violently, and stand with his muzzle extended and labouring for breath. If his general health does not seem to be affected, this *nasal gleet* will all pass away as the spring approaches. If however any of the flock should now appear to be losing flesh and strength, it is too probable that *consumption* is at hand. The only chance of saving or doing them any good will be to place them in some comfortable pasture, letting them have salt within their reach, and giving them the hydriodate of potash, in doses gradually increasing from three grains to twelve, morning and night.

Lambs, when too early and too much exposed, are subject to diseases of the upper air passages (*laryngitis* and *bronchitis*), the one attended by a ringing cough, and the other by one of a more wheezing sound. Bleeding will always be necessary for the first, with aperient medicine. A mild purgative will usually suffice for the second, or possibly an ounce or an ounce and a half of common salt may be given dissolved in six ounces of lime water.

Inflammation of the lungs, recognised by difficulty of breathing, heaving at the flanks, and distressing cough, is a disease of frequent occurrence in sheep. It speedily runs its course, and the lungs are found to be one disorganised mass. Bleeding and purging are indispensable; but as soon as the violent symptoms seem to remit, tonics, composed of gentian and spirit of nitrous æther, must follow.

Epidemics.—Sheep are not so liable to the attack of these diseases as horses and cattle. Sometimes, however, sheep suffer from epidemic diseases very seriously. They have cough, and discharge from the nose and eyes. The appetite ceases. Those that are affected by the disease separate themselves from the rest of the flock; they continually lie down, and many of them die. They exhibit after death inflammation through all the contents of the chest and abdomen, with effusion into the cavities of both. The disease is most rapid in its course. The shepherd may leave his flock in the morning free apparently from any immediate danger, and when he returns in the afternoon he will find two or three of them dead. Epsom salts with nitre may be given. Blood should be abstracted, if the case seems to require it; and the medicine should be repeated sufficiently often to keep the bowels gently open. If the purging becomes considerable, a little starch with chalk and cinnamon may be serviceable. Those that will eat should be foddered with good hay, and the others forced with gruel, being kept dry and comfortable with plenty of clean straw under them. The detached horn should be pared from the feet where there was any separation, and the parts washed with a solution of blue vitriol, and then smeared over with melted tar. The mouth and tongue, on which there generally are some ulcers, should be dressed with a strong solution of alum in water. Under this treatment most of the patients will probably recover.

Garget.—Inflammation of the udder is more frequent in the ewe than in the cow. The udder should be well fomented with warm water, and then, if there are no large knots or kernels, she should be returned to her lamb, whose knocking about of the udder will generally be productive of good rather than harm. If, however, she refuses the lamb, a drachm of camphor and mercurial ointment may be well incorporated with an ounce of elder ointment, and a little of it well rubbed into the udder every morning and night. If the udder should still continue to enlarge, a free incision must be made into that part where the swellings are largest. A weak solution of chloride of lime should then be applied, and when the putrid smell is gone, the Friar's balsam should be used. In a few days the wound will generally be healed, and the lamb may be returned to its mother.

Diseases of the Feet.—There is a small opening at the bifurcation of the pasterns, which leads to a canal running down the inner face of each to the commencement of the hoof. The function of this canal is a matter of doubt; but dirt or gravel or other foreign bodies sometimes get into these canals, and produce considerable pain, inflammation, and ulceration. The treatment consists in the extraction of any of those extraneous substances that can be got at, and the fomenting and poulticing, or scarifying the parts, or effecting incisions into the canal, and applying a caustic or a balsam, as the case may require.

The treatment of *foot-rot* essentially consists in paring away all loose and detached horn. This is the corner-stone of skilful and successful practice. All fungous granulations must either be cut away, or destroyed by the muriate of antimony, and the foot well washed with a solution of chloride of lime. The muriate of antimony must then be lightly applied over the whole of the denuded surface. This must be repeated daily until the whole of the foot is covered with new horn. The diseased sheep must not be permitted to join his companions until the cure is complete, for it is a sadly infectious disease, and may easily spread through the whole flock.

The Scab is a very troublesome disease, common in the spring and summer. The sheep is continually scratching himself with his feet, tearing off the wool, and violently rubbing himself against every protruding substance. The disease first appears in the form of minute pustules, but several of these unite and form a scab. The health of the sheep becomes rapidly affected under this disease, and some of them pine away and die. It is a very infectious disease, for every place against which the sheep can rub himself becomes tainted with the poison. The sheep must be housed and shorn as closely as possible, and then well washed with warm water. An ointment composed of one part of mercurial ointment and seven of lard must then be procured, and such a quantity of it as the diseased parts seem to require rubbed in on every second day. Every place in the field and in the fold against which he can possibly have rubbed himself must be well cleaned and painted before he is permitted to return. The cause of scab consists in the presence of a minute insect or tick, which may be conveyed from one sheep to another when an infected sheep comes in contact with a sound one; or it may be left on the rubbing-post, and entangled in the wool of the next animal that comes in contact with it; or it may be the product, and is too often so, of disease of the part. It is of spontaneous origin, as well as the product of contagion, and is called into existence by the derangements which our neglect, or accident, or disease has made in the skin. This is a view of the case that should never be forgotten by the sheep-owner.

Lice and *Ticks* will be best got rid of by the application of the mercurial ointment just recommended.

The Fly.—Several species of fly frequently deposit their ova on the wool of the sheep. If there are any sore places, they are selected for the habitation of the larvæ. The head, as the most exposed part, is the one oftenest attacked, and the sheep are sadly tormented by the fly and the larvæ. The best preservative or cure is the application of a plaster composed of a pound of pitch and a quarter of an ounce of bees' wax, spread on soft leather or linen. The attack may however be generally prevented by the application of a small quantity of spirit of tar to the head or any bare or sore part. Two or three applications of this will be sufficient for the whole of the summer, and not a fly will approach a sheep thus guarded.

SOIL. Wherever the surface of the earth is not covered with water, or is not naked rock, there is a layer of earth, more or less mixed with the remains of animal and vegetable substances, in a state of decomposition, which is commonly called the *soil.*

The nature and composition of the soil, and consequently its greater or less aptitude to the growth and maturity of vegetable productions, depend chiefly on the proportion and mechanical structure of the various substances of which it consists. When the soil is favourable to the chemical action by which the elements are combined to form vegetable substances, and admits that quantity of air and moisture without which this chemical action cannot take place in any given climate or temperature, vegetation goes on rapidly, and all the plants which are suited to the climate grow in the greatest perfection, and bear abundant fruits.

It is not however very frequently the case that a soil possesses all those qualities on which great fertility depends. So many circumstances must concur to make a soil highly fertile, that the great majority of soils can only be made to produce abundantly by being improved by art both in their texture and composition. Hence the practice and science of agriculture, which is founded on experience, but to which every progress in science also affords great assistance, by the additional light which every new discovery throws on the true theory of vegetation.

There are various modes of distinguishing soils, without entering into a minute analysis of their component parts. The simplest and most natural is to compare their texture, the size and form of the visible particles of which they are composed, and to trace the probable source of their original formation from the minerals which are found around or below them, or the rocks from which they may have been slowly separated by the action of the elements. The science of geology, which teaches the relative position and nature of the minerals of which the outer crust of the earth is formed, is consequently of the greatest utility in aiding us to compare different soils and ascertaining their composition.

The knowledge which geology imparts is however not sufficient for the minuter classification of soils; for it is found by experience that the soils which lie over or near the different strata, as they appear near the surface, vary greatly, although they retain some general character which distinguishes them from others. The streams which descend from the hills, and flow towards the valleys, and through them to the sea, carry to a great distance the minuter portions of the minerals which they flow over in their course, while the larger and heavier are deposited much sooner. Hence the heterogeneous mixture of various earths and stones, and their stratification in thin layers, as is often found when a soil is examined which has never been disturbed by cultivation. A sudden flood, rising rapidly, carries stones and fragments of rocks in its course, while a gentler stream deposits fine sand or clay over these, and forms every variety of sandy, gravelly, or clayey soil. If chalky hills are near, carbonate of lime abounds in almost every proportion, with its usual concomitant irregular flints. If the waters have accumulated in a basin, and formed a temporary lake, the soil will consist of all the finest portions of the minerals, which from their minute size have remained long suspended in the still waters, and slowly deposited in the form of mud. In proportion to the shallowness of the lake, vegetable matter will have been produced, and intimately mixed with the minerals; and where vegetation has gone on rapidly, peat and soft bogs are formed.

It is not sufficient to class soils according to the substance which predominates, as has been usually done, such as sandy, gravelly, chalky, or clay soils; for this gives very imperfect information respecting their nature or fertility; neither is it altogether sufficient to class them according to any particular geological formation. It is important to enter into a more minute examination of their component parts. But as the geological investigation of the different strata is a great help in the examination of soils, we will in the first place give a short description of those which have the most distinct characters, from their connection with different geological formations.

The soils which are immediately derived from those rocks in which no traces of organic remains are to be found, consist either of visible fragments of quartz and other hard minerals, which are not affected by exposure to air or water, and are only ground and comminuted by being rubbed against each other in floods and torrents, or of minuter particles of the same, of which the shape is not readily distinguished by the naked eye. When they are altogether composed of visible particles and stones, the water readily passes through them; and unless they are kept continually moist by a regular irrigation, without any stagnation of the water, they are absolutely incapable of sustaining vegetation, or of bringing fruits to maturity. It is seldom, however, that any gravel or sand does not contain some portion of earth or other matter, of which the particles become invisible when diffused through water, and to which, for the sake of perspicuity, and to prevent confusion, we will here give the general name of *impalpable substance.* A certain portion of this finer part of the soil, and its due admixture with the coarser, especially where there is some regular gradation in size, and no stones of too large dimensions to obstruct the instruments of tillage, may be considered as essential to fertility. The chemical composition of the impalpable substance no doubt greatly affects the degree of fertility; but the general texture must be considered as by far the most important circumstance. To improve this texture permanently is the great object of all the labours of the husbandman. For this purpose he carries various earths from one spot to another; clays one field, and limes or chalks another; brings peat upon sands and clays, and carries gravel and lime on his peat-bogs. Without an adequate knowledge of the composition and texture of a soil, it is impossible to make permanent improvements with any certainty, or without incurring the risk of failure or of useless outlay.

The soils which have been formed from the disintegration and decomposition of the primitive rocks, such as granite, basalt, schist, or limestone, and especially those which contain all these minerals minutely divided and intimately mixed, are always naturally fertile, and soon enriched by cultivation. The hard particles of quartz maintain a certain porosity in the soil, which allows air and moisture to circulate, while the alumina prevents its too rapid evaporation or filtration. The silicate of potash also seems highly favourable to the vegetation and growth of those plants which contain silica in their stems, such as the gramineæ, especially wheat, of all plants the most important to the husbandman in our northern climates. If organic matter be an essential ingredient in a fertile soil, it is soon produced by cultivation, or added by judicious manuring.

Where there is a deficiency of impalpable matter, and the fragments of the rocks of which the soil is composed are large, and lie loosely, it is in vain to expect vegetation, except along gently flowing streams, which supply the roots with moisture, and thus form a bed of vegetable matter; but in a climate suited to the vine, and in a good exposure, these loose soils often produce excellent wine, as may be seen along the steep banks of the Rhine and other rivers. The roots of the vine run deep into the fissures of the rocks below, and there find nourishment suited to their nature.

The primitive limestone, which is very hard, is yet gradually decomposed by the action of air and water, being, in a very small degree, soluble in the latter. The water which flows through these rocks is soon saturated; but when it springs out and comes to the light, the carbonate of lime is deposited by the evaporation of the water; and, if this meets with the clay which results from the decomposition of the slate, it forms a marl, which naturally or artificially added to silicious sand, forms the basis of a very good soil, particularly well adapted to pasture.

The soils which have been evidently formed from the rocks which are supposed to be of secondary formation, are fertile according to the proportion of the earths of these rocks which they contain. It is of these chiefly that those loose sandy soils are formed of which the particles appear as distinct crystals, easily distinguishable with the aid of a lens, or even by the naked eye. Air and water have been the chief agents in the decomposition of those secondary rocks called sandstones, and agitation in water has washed from them the finer portions which have remained suspended. The immense sandy plains which are either barren or have been fertilized with great trouble and expense, have probably once been the shores of the sea, from which the waves have washed all that portion which was impalpable and easily suspended in water, depositing this in the depths, which, by some convulsion of nature, may some time or other be raised above the level of the waters, and form hills or plains of clay, such as are often found in extensive basins of great depth.

Argillaceous earth exists in some proportion in almost every rock. Some of the hardest gems are chiefly composed of alumina. It has the property, when mixed with other substances, as silica or lime, of fusing into a stone of great hardness and insolubility. In this state its effect on the soil is not to be distinguished from that of silica; and by burning common clay, or clay mixed with carbonate of lime, a sandy substance is produced resembling burnt brick, which tends greatly to improve the texture of those clays which contain little or no sand in their composition. It must be remembered that the stiffest clays contain a large portion of silica in an impalpable state; but this, instead of correcting their impermeable and plastic nature, rather adds to it. It is only palpable sand which with clay forms what is commonly called loam, and which, when the sand is in due proportion with a mixture of organic matter, forms the richest and most easily cultivated soils. Some of the rocks of secondary formation contain a considerable portion of alumina and lime; and when these earths meet with crystallized sand, a compound, or rather a mixture is formed, which has all the requisite qualities as to texture, to produce the most fertile loams. The only deficiency is that of organic matter; but this is so readily accumulated wherever vegetation is established, or can be so easily added artificially, that these loams may always be looked upon as the most favourable soils for the usual agricultural operations: and if a considerable depth of loam is found, which neither retains water too long nor allows it to percolate too rapidly, it may be looked upon as a soil eminently capable of the highest degree of cultivation, and on which no judicious outlay of labour will ever cause loss or disappointment to the farmer.

The greensand which lies under the chalk, and appears near the surface in several parts of Britain, consists of silicious, argillaceous, and calcareous earth, intimately combined and in a high state of subdivision, and yet not forming a compact paste with water so as to dry in hard lumps, but having rather the loose appearance and granulation of fine sand, whence its name. On this soil are found the finest wheats; but such is the variety of its form as it approaches towards the chalk or crystallized sand, or the plastic clay, that the soils which it forms have every degree of texture, from loose sands to stiff marls, whose chief use is to mix with other soils and improve them. In general, however, it may be said that the soils of which the greensand forms a considerable part are productive and easily cultivated, and that they repay the labour and manure expended on them better than most others. A narrow strip of this sand crosses Bedfordshire, and in the neighbourhood of Sandy and Biggleswade are raised some of the finest culinary vegetables which come to the London market. This sand, though light in appearance, and very easily worked, contains much of the impalpable substance mentioned before; and this, with careful cultivation and manuring, makes it peculiarly suited for gardens as well as for corn-fields. In its natural state it is easily distinguished from other sands by certain dark particles in it, which give it the greenish hue from whence it has been called greensand, and also by its effervescence with strong vinegar or any other acid.

Chalk is perhaps the mineral most widely spread throughout Britain. The chalk formation of itself forms a very poor and barren soil. In the course of ages the surface of the chalk has been covered with a thin coating of soil, consisting of chalk and organic matter chiefly. On this soil the finest and most aromatic plants are found, but of minute dimentions, affording a sweet short pasture, much relished by sheep. The constant treading in of the dung of the sheep, and the stimulating effect of their urine, gradually increase the quantity of vegetable and animal matter; and thus the turf becomes close and rich: but if this thin coat be disturbed by the plough and mixed with the chalk below, it will, after one or two tolerable crops of corn, be reduced to its original sterility; and it requires ages to restore the fine pasture which once covered it. Such is the case with those hills which are called the South Down Hills, in Sussex and Wiltshire, on which are bred the excellent sheep which bear that name.

But the chalk has in many places been

carried down by the rains and transported in a comminuted state to the sandy or clayey valleys around them, and by the mixture has greatly improved both, forming various loams and marls in themselves highly fertile, or very useful in increasing the fertility and texture of other soils. Chalk has the peculiar property of neutralising acids of every description, and of preventing their formation in the soil by the fermentation of vegetable substances; while it assists in that slow decomposition which causes the evolution of carbonic acid, and thereby assists and invigorates vegetation. The presence of carbonate of lime, if it does not exceed a third part, and if it is intimately blended with alumina and silica, is always a sign of fertility, especially when loose sand is mixed with it, so as to form one-half of the whole soil. This is called a light calcareous loam, and is usually found on the slopes or around the base of chalky hills.

The Weald clay consists of very minute particles of alumina and silica, forming a tough unctuous earth, fit for the growth of oaks, with very few stones or visible particles. This soil is found in Sussex and Kent chiefly. The plough cuts it into continuous slices, when it can be ploughed, which is only in a certain state of moisture; for when it is dry, the surface is as hard as a rock, while the subsoil is continually moist, the water being unable to pass through its pores. It has the most unpromising aspect, drying into hard lumps like brick, and apparently incapable of being brought to such a state of mellowness as to admit the seed or cause it to vegetate; yet this stubborn soil may be rendered fertile by tillage, draining, and exposure to frost in winter: and its tenacity may be corrected by the application of lime, ashes, and other substances, especially fresh stable-dung, which interpose and prevent the clods from reuniting into one tough impervious mass. Lime and chalk do this most effectually; and when the weald clay has been brought to a looser texture, it produces beans, wheat, oats, and clover in great perfection.

The system of complete under-draining by parallel drains, at the distance of from 10 to 20 feet, which carries the moisture into the surrounding ditches, has in many instances so greatly improved the weald clays, that those who had formerly attempted to cultivate them can scarcely believe their eyes when they see the abundant crops produced. Subsoil ploughing has also done wonders after complete draining, in some cases rendering the soil so mellow and loose as to allow of the cultivation of turnips, especially the Swedish. As clay soils predominate in England, and their improvement has been almost despaired of, it is of great importance that it should be generally known that no soils repay the cost of improvement better than clays, provided the surface be such as to admit of perfect draining.

Another clay is called the Oxford clay. This is of a bluish colour, which alters on exposure to the air, probably from a change in the oxidation of the iron which it contains. This clay is favourable to the growth of grass, and some of the richest pastures in Wiltshire and Oxfordshire have it for a subsoil, over which the decomposition of the roots and leaves of the grasses has formed a layer of vegetable mould of the highest degree of fertility. In the fens of Lincolnshire the Oxford clay is covered by a coat of peat, formed by the decomposition of aquatic plants, which have accumulated wherever the water had no natural exit. When these fens were laid dry by an extensive system of draining, the peat was converted into a rich soil by the admixture of the clay which was found under it.

The *Oolite* formation contains much carbonate of lime cemented by an unctuous earth into a species of stone. The soil which lies over this stone, and which is of nearly the same nature, but broken and disunited, is various in its qualities. Sometimes it is of great fertility, and sometimes nearly barren, according as the impalpable matter in it abounds and contains a due proportion of the different earths, or it resembles a loose chalky sand, in which moisture is retained with difficulty. In the first case it produces every kind of grain in abundance with moderate cultivation. In the latter it requires a great outlay of manure which readily disappears, and it is justly called a poor hungry soil.

On the red sandstone is found a soil which is usually of the finest quality. The fine loose soils of Devonshire and Somersetshire are of this description. It unites most of the requisites of a good soil in its texture, neither too close nor too loose, and in the impalpable matter in its composition. It is peculiarly adapted to the growth of potatoes and all roots which form the basis of a judicious cultivation. When it contains a proper portion of calcareous earth, it may be reckoned amongst the most fertile soils, and where this is deficient, the addition of lime or chalk is the best means of improving it. The calcareous earth seems greatly to add to the effect of the usual manures, so that a much smaller portion is required to produce good crops.

The neighbourhood of coal, however valuable it may be to the proprietor of the land in a mercantile point of view, is generally accompanied by a great degree of poverty in the soil wherever this mineral crops out to the light. Coal seems not only barren in itself, but almost incapable of being fertilised. The slate which usually accompanies it crumbles into a very poor earth, which lets the water through, and is composed of visible fragments of irregular shapes. The same may be said of the slate which rises into high hills in Devonshire and Cornwall. The strata here are generally very upright and narrow, and the water finding an easy exit downwards between them, leaves the surface too dry to favour vegetation, even if the soil which covers it were more fertile; but every portion of organic matter is carried off, and none can accumulate to form vegetable mould. The lands which are in cultivation in the valleys whither the waters have carried a mixture of earths, and where the subsoil is of slate, require much manure to produce even moderate crops.

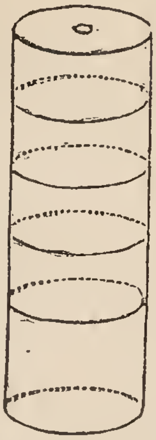
These are some of the principal natural soils found in Great Britain. It will be seen that each distinct formation gives rise to a great variety with respect to fertility, even where the basis remains the same: but it is of great importance to the farmer to ascertain the general nature of the rocks and strata on which his farm is incumbent, and no chemical analysis can determine the exact value of the land, unless the geological situation of it is distinctly known. But with this guide the analysis may distinguish the varieties, and point out the spots which can be cultivated at the least expense, or improved by the simplest means, while it may also show the deficiencies which render a soil on the most favourable formations difficult of cultivation or improvement, when these deficiencies are not easily remedied for want of those substances which are not found within reach of the farm. In all these soils no notice has been taken of organic matter, because this seems not in any great degree to be connected with their formation. The primary strata are distinguished by having no traces of organic remains in their composition. The secondary have not a sufficient proportion to call for an especial notice of it. It is in the tertiary strata, especially those which have been formed by the destruction of animal and vegetable substances, that organic matter becomes a peculiar object of attention, and from this reason alone the alluvial soils of later date are found highly fertile, whenever the circumstances which prevented their cultivation are removed; whether it be the waters which are to be shut out by dikes or carried off by draining, or a want of labourers which has left them to a state of nature, whenever the soil is turned up and the seed sown, the crops are always, for a greater or less period, certain and abundant.

The alluvial soils formed by the deposit of a variety of earths in a state of great division, and mixed with a considerable portion of organic matter, form by far the most productive lands. They will bear crop after crop with little or no additional manure, and with a very slight cultivation. These soils are found along the course of rivers which traverse extensive plains, and which have such a current as to keep very fine earth suspended by a gentle but constant agitation, but not sufficiently rapid to carry along with it coarse gravel or sand. Wherever there is an obstruction to the current and an eddy is formed, there the soil is deposited in the form of mud, and gradually accumulating, forms those alluvial soils which are so remarkable for their fertility when carefully protected from the inroads of the waters. In these soils the impalpable matter greatly predominates; but the intimate mixture of the earths with organic matter, in that state in which it has been called *humus*, prevents their consolidating into a stiff clay; and the gases which are continually evolved from the organic matter keep the pores open, and give scope to the growth as well as the nourishment of the roots. It is in the alluvial soils principally that an accurate analysis is useful; because the proportion of their constituent parts varies in innumerable degrees. It may be laid down as a general rule, that the most fertile of these soils are those in which the primitive earths are nearly in equal proportions, silica being the most abundant, with about 10 per cent. of organic matter; a greater proportion of this last would form too loose and spongy a soil to bear good crops of corn, especially of wheat. But 4 per cent. of humus, with a good mixture of earths, and some phosphate of lime from the decomposition of bones and marine shells, produces a very good wheat soil. The rich warp-lands along the Humber are artificial alluvial soils, and although they contain but a small proportion of humus, are highly fertile after their first deposition, but it is observed that they gradually become more tenacious and difficult of cultivation as this humus is carried off by the crops; and that it is soon necessary to add animal and vegetable manures to supply its deficiency.

Organic matter is no doubt essential to great fertility in a soil, but some soils require more of it than others. *Humus*, which is the form which organic matter naturally comes to by slow decomposition in the earth, gives out certain elements which the roots can take up in their nascent state, and from which they obtain the carbon which is so abundant in all vegetable productions. But organic matter in every stage of its spontaneous decomposition keeps the pores of the soil open, and admits, if it does not even attract, air and moisture to the fibres of the roots. In all rich soils which have been long cultivated, especially in gardens, there are particles of a dark colour and fibrous texture, which in the microscope appear like minute logs of charred wood. These keep the soil open, and supply carbonic acid, when the air reaches them, or they are slowly transformed into humus, which remains inert as long as it cannot imbibe oxygen and form carbonic acid by a species of slow combustion. Humus is no doubt one of the chief causes of fertility, but its presence does not appear to be so indispensable as has been imagined. A proper texture seems a much more indispensable condition. Humus can undoubtedly be formed from the elements of water and of the atmosphere. Whether it be directly or by the slow process of vegetation and subsequent decomposition, does not so readily appear, but it is certain that there are soils which are highly fertile in which scarcely a trace of humus can be discovered, and which, from their igneous formation, cannot well contain organic matter; such are the soils which are produced by the decomposition of the lava which has run in a liquid state from the craters of volcanoes. This is composed of different minerals, which have been fused by the action of heat, but in which the mixture of the earths and salts has not been in such proportions as to form a perfect glass. When exposed for a time to the influence of the atmosphere, the lava crumbles into an earth, which is neither so loose as silicious sand nor so plastic as clay, and which has such a porosity as suits the growth of the roots of vegetables. By the effect of a warm climate and frequent rains, vegetation goes on rapidly; and by cultivation humus is soon formed and accumulated, so that it is only in the more recently cultivated lavas that it can be said that vegetation goes on without any supply of organic matter; and the addition of humus greatly increases the fertility of these soils. It is much easier to supply the deficiency of humus, which at best forms but a very small portion of the soil, than of silica or alumina, which should enter into its composition in the proportion of one-half or a third of the whole. It is practicable to carry lime or chalk upon soils which do not contain calcareous matter; clay may also be carried upon loose sandy soils, where it can be found below the surface, or at a moderate distance; but if a soil is very deficient in silica, it requires so large a proportion of this earth to give porosity to stiff clay, that it very seldom can repay the trouble and expense. Hence the difficulty of bringing poor wet clay soils into a fertile state, except where an abundance of chalk and vegetable manures can be easily procured. In this case the perfect draining of the land, and exposure of the ploughed surface to the frosts of winter, with the addition of chalk and manure, produces such an alteration in the texture of the clay, that by continuing the improving process it is entirely changed into a mellow and fertile loam. The burning of a portion of the retentive subsoil into a brick-like earth gives it a porosity which renders it mechanically similar to silicious sand, and converting the iron which all these clays contain into a peroxide, the soil is thereby greatly improved in fertility; for it seems that iron, in a state of slight oxidation, or combined with any acid, is hurtful to vegetation, whereas the red peroxide is not only innocuous, but seems to have fertilising properties.

The comparison of the different fertile soils leads therefore to the conclusion that the texture or porosity arising from the admixture of particles of various dimensions is the most important object of examination; and subordinate to this is the chemical constitution of the earths and other substances of which it is composed. In the examination and analysis of soils for the purpose of ascertaining their power of production, we must therefore first examine them mechanically, and afterwards chemically, and on this principle has been proposed the mode of *analysing soils*, in a paper which obtained one of the first prizes given by the Royal English Agricultural Society, and published in the first number of its journal. We will here insert a short account of the process, with such alterations and additions as more extensive practice has suggested.

There are two easy methods of ascertaining the size of the particles of a soil. The first and simplest is by drying the portion under examination, gently triturating it with a wooden pestle in a mortar, so as not to produce a grinding of the more solid portions, and then separating the coarser from the finer parts by means of several metallic sieves of different fineness. A simple instrument is recommended for this purpose, which is very portable, and consists of three or four sieves fitting into each other like the percolators in a coffee-biggen; the coarsest sieve being uppermost and covered with a lid; the finest fitting into a recipient, and the whole forming a cylinder three or four inches in diameter, and from six to eight in height. The coarsest sieve has threads at the distance of $\frac{1}{20}$ of an inch, the second has 80 in an inch, the third 120, and the fourth is the finest metallic tissue which can be made. What remains in the two first is easily examined by the eye, or with the help of a lens. The third and fourth require a microscope to see whether any crystallized particles remain in the impalpable dust which has gone through all the sieves. By carefully weighing these different earths their proportion is known, and by taking the specific gravity of each their nature can be guessed at with tolerable accuracy.



As this analysis is not intended for experienced chemists, the simplest methods are preferred to the more accurate. There is a mode of taking the specific gravities of substances, which are in the form of powder insoluble in water, so easy and so little liable to error, that any person, however unaccustomed to experiments, can soon become sufficiently expert to have full confidence in the result. It is as follows: a small pear-shaped phial is

blown of thin glass, and the neck cut and ground smooth. The size is such as to contain 300 grains of water more or less; the exact quantity is not essential. It is now filled with pure water at 60° of Fahrenheit's scale, and accurately poised in a delicate balance: 100 grains weight are then placed in the same scale with this phial, and, by means of a very fine tube, water is gradually sucked out of the phial, till the equilibrium is restored; that is, exactly 100 grains of water have been taken out. A counterpoise is now made of lead or brass, when the 100 grains weight has been removed, and this serves for all future experiments. When the specific gravity of any substance is required, the phial partly filled with water is placed in one scale, and the counterpoise, made as above described, is placed in the other; water is added or taken from the phial till an equilibrium is obtained. The substance to be tried is slowly and carefully poured into the phial, until the water rises to the ground surface of the neck and stands quite level, which is easily seen by observing the reflexion of the light from the surface. It is then carefully replaced in the scale, and grain weights are added to the other scale to restore the equilibrium. The number of these grains at once indicates the specific gravity of the substance; for the space above the water was that of 100 grains of water, and this space is now filled up by the earth examined. Its weight therefore denotes its specific gravity compared to water as 100; and as a delicate balance readily turns with a decimal of a grain, the decimals give the specific gravity to the third figure. Thus if the grains are 256 and the decimals 4, the specific gravity is accurately 2564, water being 1000.

By taking the specific gravity of the pure earths, it is found that silica is the heaviest, the next is carbonate of lime, and the lightest is alumina, while organic matter is much lighter than any earth. Thus a tolerable guess can be made of the composition of that impalpable portion of the soil which generally contains all the salts and organic matter. To separate these chemically requires more experience and a more extensive apparatus; but the quantity of carbonate of lime in any soil which effervesces with acids, when its presence is thus ascertained, can be calculated by a simple process, almost as easily as the specific gravity: for this purpose it is necessary to have a balance with a somewhat larger scale, in which can be conveniently placed a small glass cup and a phial. The cup is placed in the scale with 100 grains weight in it; and the phial, also containing 200 or 300 grains, more or less, of very dilute muriatic acid. The whole is accurately poised. Fine dry sand is the most convenient counterpoise, when the exact weight is not required. The 100 grains are now taken out, and replaced by the dried soil to be examined; when the equilibrium is restored, the diluted muriatic acid is poured carefully and gently on the earth in the cup, as long as it continues to effervesce. It is then left for a while, and a little more of the acid added. If no bubbles appear, then all the carbonic acid has been expelled, and the opposite scale preponderates. The grains and decimals of grains required to restore the equilibrium give the weight of the carbonic acid expelled, which will sometimes be considerable. Since 100 grains of carbonate of lime contain 44 grains of carbonic acid, we have only to take the proportion as follows: let a denote the grains of carbonic acid indicated in the experiment: then, $44 : 100 :: a : \frac{100a}{44} =$ the quantity of carbonate of lime in the soil. That is, multiply the grains added to the scale by 100, and divide by 44. This experiment repeated with a very accurate balance will surprise by its correctness; and no chemical analysis could give it with equal certainty, especially in the hands of an inexperienced person. When the weights are ascertained by substitution, the accuracy of the balance is of less consequence; all that is required is that it be sensitive, or turn readily by the addition of very minute weights. Thus by two simple and easy experiments, some of the most important qualities of the impalpable portions of a soil may be accurately ascertained viz. its specific gravity, and the quantity of carbonate of lime which it contains.*

It is more difficult to separate the fine silica from the alumina, and this is of less importance than might be supposed; for silica, when extremely divided, so as to remain long suspended in water, and mixed with alumina, becomes as impervious to water as alumina itself, and therefore its mechanical effect on the soil is the same. Phosphate of lime, where it is found, is no doubt of importance; but this requires a much greater knowledge of chemistry to separate it than is presumed in practical farmers, for whom this is chiefly written. Gypsum likewise has a considerable effect; but these substances are not generally diffused, and may always be suspected when the rocks and minerals in the neighbourhood indicate their presence; in which case it is prudent to submit the soil to a strict chemical analysis.

It is however very important to know how much organic matter exists in a soil, especially in alluvial soils. The specific gravity of the impalpable portions will often give some idea of this, when organic matter abounds, as in peaty soils. But the only sure test is its destruction by fire. This must be done very carefully. The soil must be dried and heated over a lamp to about 300° of Fahrenheit, stirring it often. This will expel the water, but not burn the organic matter or humus. It is then weighed in an open platinum capsule, and heated very gradually over the lamp, or in a clear fire, continually stirring it with a glass rod till it appears red: very minute portions of pure nitrate of ammonia may be added from time to time, taking care that there be no decrepitation, so as to throw any of the earth out of the capsule. After it is supposed that all the organic matter is destroyed, and expelled in the form of vapour or gas, the capsule is accurately weighed, and the loss indicates the quantity of organic matter in the soil. It will require some correction; for if alumina abounds, it will have retained some water, even after the first heating, which a red heat will have expelled. But this is not of very great importance in a mere comparison of different soils, for the same circumstances will be common to all.

The coarser portions of the soil, which have been separated in the sifting, are easily examined by the eye. If repeated washing carries off nothing from them, they may be considered as so many crystals, which have no other effect in the soil than to keep it open. If some of these are of a calcareous nature, they will dissolve with effervescence in muriatic acid, and their proportion can be ascertained by the process above described; if not, they may be all considered as mere silicious sand or gravel.

A good soil is composed of one-third coarse sand, one-third very fine sand, and one-third impalpable matter, in which there is silica in the greatest quantity, alumina and lime in a smaller, and from four to ten per cent. of organic matter, without any appearance of tannin, which is readily discovered by pouring into the water which has filtered through it a weak solution of sulphate of iron; if a blackness appears, the gallic acid is present, and in proportion to its quantity the soil is less fertile. In this case quicklime is the best corrective.

In ascertaining the value of a soil for the purposes of agriculture, two circumstances should be carefully noticed. The first is the permeability of the soil to water; and the second is its power of absorbing moisture from the atmosphere. To ascertain the first, it is only required to place an equal weight of different soils in glass tubes of equal diameter, pressing them so that they shall occupy equal spaces, but not filling the tubes. Then pour an equal quantity of water over each soil, and place them upright with cups under them. Examine which has the surface first dry, and how much water runs through each in a given time. That which presents a dry surface, while it holds most water in its pores, is probably the best. To ascertain the comparative absorption of moisture, the soils are dried in pairs on a plate of metal heated by steam, or at a heat of 212°, to expel the water. They are then placed in equal quantities in similar flat cups or dishes, and placed in opposite scales of a balance, and poised. The apparatus is exposed to a moist atmosphere out of doors, or in a cellar, and occasionally examined. That which is heaviest is, in general, the most fertile, and contains most humus. If there are more than two soils, they are compared with each other, and with a third as a standard.

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* A very neat instrument has been invented by Dr. Ure to facilitate this operation. It consists of a bent tube with two bulbs, which communicate by a very small aperture, one bulb being a little above the level of the other. The whole can be suspended from the arm of a balance. The diluted muriatic acid is poured into the lower bulb, and the earth into the other. By inclining the instrument the acid is gradually made to pass into the bulb containing the earth. Thus the carbonic acid is expelled without danger of loss by ebullition, and the loss of weight is accurately ascertained.

By these simple means any person, however ignorant of chemistry, or unaccustomed to make accurate experiments, may soon satisfy himself as to the comparative value of different soils which have never yet been cultivated; how they may be improved, and what crops are best suited to them;—things of the greatest importance to those who go to distant colonies in the hopes of obtaining good land at a moderate price, and cultivating it to advantage.

But we have intimated that there were other means of ascertaining the mechanical texture of soils than by sifting them. This is by washing with pure water. For this purpose nothing is required but a few flat plates and large cups. Some of the soil is formed into a very thin mud by stirring it in a cup nearly full of water. The finer particles are successively poured off from the sand or grit, which at last remains pure, so that the water added to it is no longer discoloured. This being dried and weighed, gives the coarse sand. The water and earth poured off are allowed to settle. A common soup-plate is found a very convenient vessel for this purpose. On the surface of the deposited earth will be found all the undecomposed vegetable matter, which with a little care is easily taken off, dried, and weighed. The finer portions of the earth can be poured off successively by shaking the whole moderately, till nothing but very fine sand remains. The alumina and impalpable silica will remain long suspended in the water, and allow any sand yet remaining to be deposited. They may be rapidly separated from the water by filtration through stout blotting-paper; but it is preferable to pour them into a glass tube about one inch in internal diameter, with a cork fitted into the lower end. In this tube the earths slowly fall to the bottom, and any variety in the size of the particles causes a line more or less distinct, which can be observed through the glass; and thus a very good idea may be obtained of the proportion of the different earths, as far as regards the size of their particles. For their chemical differences, the preceding process must be adopted.

It is often useful to ascertain nearly the composition of a soil, without having time or opportunity to make accurate experiments. A graduated glass tube, which can be carried in the pocket, and a small phial with a ground stopper, containing diluted muriatic acid, and secured in a wooden case for fear of accident, is all the apparatus required. A little of the soil is taken and moistened with water; a few drops of the acid are poured on; and by the greater or less disengagement of bubbles the proportion of calcareous matter is guessed at, and its presence proved. The soil mixed with water is poured into the glass tube and well shaken. In a few minutes the coarse sand is deposited: shortly after the finer sand, and, lastly, the clay and impalpable matter, of which the lightest remains longest suspended. Distinct rings can be observed in the deposits, and the graduated tube shows their proportion. A person accustomed to this method will guess with great precision the general qualities of the soil; and when the geological structure of the neighbourhood and the nature of the subsoil are taken into consideration, the value of the land for pasture or cultivation is guessed with little danger of making very glaring mistakes. To surveyors and valuers this method is of very great help, when other means are not at hand.

In practice, soils are usually divided into light, mellow, and stiff; but this gives very little information, there being every imaginable variety in each of these. In the article Arable Land, we have given a more particular classification from Thaer, but this is found chiefly applicable to alluvial soils. There are still minute circumstances which produce great fertility or the reverse, and which it is difficult to investigate. An accurate chemical analysis, joined to a careful mechanical examination, and very correct accounts of the average produce under different systems of cultivation, can alone give us a scale according to which the natural fertility of different soils can be classed; and this must be the work of time and industry joined to science and practical knowledge. We shall therefore conclude this article by recommending to every lover of agriculture to observe and note the peculiarities of the soils with which he is best acquainted; to analyze them frequently and under various circumstances, and thus endeavour to find to what peculiar substance or condition is to be ascribed a greater or less degree of fertility; so as to lead to the simplest and easiest mode of rendering indifferent soils fertile, and increasing the productive power even of the best.

SOILING is the name given in agriculture to the mode of feeding horses and cattle in the stable or yards with food brought to them as it is cut in the meadows or fields. The great advantage of soiling cattle is the increase of manure of the best quality which is thereby produced; and this circumstance alone can counterbalance the great trouble and expense incurred in cutting and carrying all the green food from a distance to the farmyard.

The system of soiling is not very generally adopted in British husbandry, it being so much easier to allow the cattle to crop their food in the pastures; but in those countries where property in land is greatly subdivided, and where farms are small and good pastures scarce, as in Flanders, France, and Switzerland, especially where the vineyards render manure scarce and dear by taking a considerable portion of it and returning none, there the soiling of cattle is almost a matter of necessity. A cow or ox requires from two to three acres of pasture or meadow to feed it all the year round, allowing a portion for hay. But by raising clover, lucern, sainfoin, tares, and other green crops, three cows or more can be fed with the produce of one acre, especially if a portion is in turnips or other succulent roots. Thus the straw of the white crops is converted into excellent manure, and the land kept in a state of fertility.

In proportion as a farm is larger in extent, so the expense of soiling increases, both from the distance of the fields where the green crops grow, and from the same distance to which the dung is to be carted. There is a limit therefore to the soiling system, unless there be many yards or stables in different parts of a farm, so as to subdivide it, and make each yard the centre of a distinct system of soiling, with fields near at hand for the green crops. In almost every experiment on a large scale it has been found that soiling was only a certain mode of purchasing dung, and that it often was more expensive to procure it in this way than to send to a considerable distance to purchase it in towns. Where it cannot be purchased at all, there are no other means, in many situations, of producing a sufficient quantity; and the trouble and expense of soiling must be submitted to. In almost every case where sheep can be folded to feed off the crops, the soiling of cattle is a loss, because the sheep pay something for their food; the cattle in the stall seldom do.

But there are animals which must be fed for the work of the farm; such as horses or oxen; and these are much more profitably and economically fed by soiling than by any other means. A horse or ox, if he works eight or ten hours, has no time for rest if he has to crop his food from a short pasture, however sweet; whereas an abundant supply of clover, lucern, or tares enables him to take a hearty meal and lie down to rest. He wants no corn with this food, and does his work without losing flesh or activity.

There is nothing easier in a mild climate, and especially a moist one, like Britain or Ireland, than to have a succession of green food from the beginning of spring to the end of autumn. Rye and winter barley, sown early in autumn, will be ready to cut as soon as the mild weather of spring commences: some sown later with winter tares, and the young clover, which has not been cropped in autumn, will succeed. After this come artificial grasses, as Italian rye-grass and the grass of water-meadows mown early; although this last is not so hearty food for working cattle; but when joined to a mixture of oats and cut straw, their watery nature is corrected. Clover and spring tares (when these last are sown at proper intervals), lucern and sainfoin (if the soil is suited to them), will afford a constant and abundant supply to the scythe which cuts the daily allowance. It is prudent to provide against failure, and have more land in these crops than is absolutely necessary, because the surplus can always be made into hay or reserved to ripen its seed; and these green crops, valuable as they are, far from deteriorating the soil, clear it of weeds, and render it more fit to bear corn afterwards. In this case soiling is profitable and economical.

It is generally thought in those countries where the soiling system is most universally adopted, that it is best to allow the green food to remain twelve or twenty-four hours after it is cut, before it is given to cattle. This may be prudent with cows and oxen, who are apt to eat voraciously, and are subject to be hoven from the fermentations of the green food in the paunch or rumen: but for horses there is little danger; and if the food is not wet with dew or rain, the fresher it is eaten, the better it will nourish the animal, and the more he will relish it.

If any one is desirous of calculating the expense of soiling any number of beasts, he has only to reckon what time of men and horses it will take to cut the food and carry it to the cattle, from the average distance of the fields in which it can be raised in succession. Much of their time is lost in the morning and evening in going backwards and forwards from the field to the yard; for there can scarcely be an establishment so large as to keep them employed a whole day; and if there was, the fields must be so large and so distant, as to greatly increase the expense of carriage. Not to enter into minute calculations, it is fully proved that, to a certain extent, soiling is profitable and economical, when it can be done before and after the usual hours of labour; but that when undertaken on a large scale in any one locality, it is usually attended with loss, the manure produced being purchased at too great a price.

If a labourer who has an allotment of half an acre of good light land would devote it entirely to raise food for a cow, his wife and children cutting the food and tending the cow in a small yard with a shed, or in an airy cow-stall, he would find that he had a much greater clear profit, than if he had sown his land every year with wheat, and had always a good crop, which last supposition is impossible. There would be no better stimulus to industry than to let a piece of land for this purpose to every man who could purchase a cow and feed it by soiling.

SOMERSETSHIRE AGRICULTURE.—The county of Somerset possesses a soil and climate well suited to the growth of wheat and all the agricultural produce usually raised in any part of England. The hills do not rise to any great height, and are mostly cultivated or in profitable pasture. There is a fair proportion of woodland without any extensive forests. In some of the vales, such as the extensive vale of Taunton, the soil is of a rich nature, and the wheat which is produced there is of superior quality, so as to be much sought after for sowing in other parts of the country. Excellent butter and cheese are made where the land is better adapted to pasture. The Cheddar cheese, which, from its superior quality, gives its name to a great portion of the cheese made in the county, is reckoned by many to be the best cheese made in England, from pure milk without any addition of cream: the real Cheddar cheese is consequently scarce, and bought up as soon as it is made.

The cows are mostly of the Devon breed; but many short-horns are also to be found in the dairies. The oxen fatted are either Devons or Herefords and short-horns. Many of the landed proprietors have farms in their own hands, and show their tenants an excellent example in the choice of their cattle and sheep, and in introducing improvements in the cultivation of the soil, so that the state of agriculture has greatly improved within a few years: better implements are used, and more profitable rotations of crops are introduced than in the old triennial system.

The sheep on the best lands are of the Leicester or South Down breeds, with crosses between these and the Cotswold sheep, which increases their size. Some Dorset ewes are kept for early lambs, which are fatted for the Bath and Bristol markets. The railway which now traverses the county will probably increase this species of industry.

There are a few hops grown in the county, but no very extensive hop-gardens; nor is there much cider made, although there are some good orchards.

Many hogs are fatted, and very good bacon is cured; the breed of pigs is like the Hampshire and Berkshire, which have of late years been improved by crosses with the Essex and Neapolitan breeds. Greater attention is paid to the breed of pigs than formerly.

The farm horses are generally strong and active; and although some heavy waggons and old-fashioned ploughs are still met with, light carts and ploughs begin to be appreciated and gradually supersede the old implements. Somerset is decidedly improving in its agriculture, and keeps pace with the progress which is visible throughout the whole kingdom.

SOWING AND SOWING-MACHINES.—The sowing of the seed has always been looked upon as one of the most important operations of husbandry. Much of the success of the future crops depends on the time and the mode in which the seed is committed to the earth. After the land has been well prepared by judicious tillage and manuring, many accidents and circumstances may disappoint the hope of the farmer, and the crop may be scanty or fail altogether. The weather and the seasons are not under his control, and he must submit to the dispensations of Providence with pious resignation; but much also depends on his own judgment and skill. If he selects the best seeds, chooses the proper season for sowing them, and has them carefully distributed and properly covered with earth, as their nature requires for the most perfect germination, and thus also protects them from the voracity of birds or insects, he will have a much greater prospect of success, under all circumstances, than if he were careless or negligent.

The most common mode of sowing the seed is by scattering it as evenly as possible over the ploughed surface, as it lies in ridges from the plough. The harrows follow, and crumbling down the ridges, cover the seed which has fallen in the hollows between them. It requires an experienced sower to scatter the exact quantity over a given surface, without crowding the seed in one spot, and allowing too great intervals in another. Hence the farmer who does not himself sow the seed, invariably chooses the most experienced and skilful labourer to perform this work. Notwithstanding every care and attention on the part of the farmer or master, the labourer will often relax and become careless, and the result appears only when it is too late to remedy it. This has given rise to the various attempts which have been made to invent machines for sowing the seed, such as should insure perfect regularity. Of some of these we will now give a short account.

One of the simplest of these machines consisted in a hollow cylinder, with one or more rows of holes in a line parallel to the axis. These holes can be stopped in part if required. The seed is put into the cylinder, the length of which is equal to the width of the land, or stitch, which it is desired to sow at a time. By shaking this when held horizontally and at right angles to the path of the sower, the seed is scattered with considerable regularity: one inconvenience of this instrument is that it requires to be filled frequently, and that much still depends on the attention of the operator. Accordingly it was very soon laid by. The idea however was followed up and improved upon in the *sowing-barrow*, an instrument still extensively used for sowing grass-seeds. It consists of a wooden trough placed on the frame of a light wheelbarrow. An iron spindle, furnished with circular brushes at regular intervals, runs the whole length of the trough, and is turned by means of simple machinery connected with the wheel. Opposite each brush is a brass plate, with holes of different sizes, which can be partly closed by means of a circular slide. According to the size of the seed to be sown and the quantity to be scattered, the holes are opened or shut. The seed is put into the trough, which has a cover or lid; and by merely wheeling the barrow in a straight line, a breadth is sown equal to the length of the trough, usually 12 or 15 feet. But this machine cannot conveniently be used in windy weather, which disperses the seeds irregularly; and it is very little superior to sowing by the hand, except in the case of small seeds, which cannot so well be spread evenly by the hand.

The drill husbandry has suggested other more complicated machines, of which some account will be found in the article Drill. The principle of these is to deliver the seed by means of funnels, each corresponding to a small furrow made by a coulter placed immediately before the funnel; and some of these machines perform the work very regularly and satisfactorily. As the inequalities of the ground require that the coulters should move up or down, to allow for these inequalities, the seed cannot be accurately deposited at a given depth; and some improvement in the mode of drilling is yet desirable, and has in some measure been effected. The patent lever-drill in common use is very imperfect in its work, and the remedy lies in the greater attention to the preparation of the surface. When this is effected, the levers may be set aside, and a much simpler drill, such as was used at first, may replace it. The object is to make furrows of equal depth in which to deposit the seed, and to cover this uniformly. The land must consequently be more carefully prepared by repeated harrowing and rolling, till the surface resembles the seed-beds in a garden. A simple drill, which makes equidistant furrows at a given depth, in which the seed drops regularly, will then do better work than a more complicated machine; but if still greater accuracy and perfection are desired, the dibble must be had recourse to. No one will deny that seed deposited by means of a dibble is distributed more equally and covered with a more equal depth of soil than by any other means, and that there is a great economy of seed in this mode of sowing; but the slowness of the operation, and the number of hands it would require to dibble all the seed on a large farm, have prevented its being very generally adopted. [Arable Land.] Many attempts have been made to invent machines to imitate the work done by hand in dibbling, and hitherto with no marked success, owing chiefly to the difficulty of clearing the dibbles from the adhering soil, and making a clean hole, and also of letting the seed fall exactly in the dibble-holes. Several patents have lately been taken out for dibbling machines, of which we shall only notice three. The first machine consists of large hollow discs, armed at the circumference with blunt projections or knobs, which make a depression in the surface as the disc revolves: these knobs are hollow, and open by one half sliding upwards as the knob leaves the depression it has made. The seed which has been deposited in the hollow knob falls into the hole. This machine is said to do its work well, and was exhibited at the meeting of the Royal Agricultural Society at Liverpool, in 1841.

The next is Bradshaw's patent, which is not so generally known, having only been tried by the inventor and his friends. Here the dibbles are moved up and down by means of a crank or eccentric circle, and are twisted in the ground by means of a projection from the shank of the dibble, which is connected with the frame of the machine; and when the dibble is moved by the crank, the rod is twisted by the difference in the motion of the crank and the machine. The seed is delivered by means of a cylinder with cavities in its surface, which revolves very near the ground, the seed being kept in these cavities by a leather belt, which only lets them out at the lowest part.

The last, of which the specification was only enrolled the 25th Nov., 1841, and is somewhat on the same principle, was invented by the late Rev. W. L. Rham, of Winkfield, Berkshire. This machine, which was exhibited at the meeting of the Royal Agricultural Society of England at Liverpool, in 1841, is thus noticed by the judges of the implements appointed by that Society:—

'The Rev. W. L. Rham, of Winkfield, Berkshire, exhibited an implement, the principal object of which is to extend and improve the system of drilling and dibbling wheat, beans, &c. It is chiefly in its latter capacity, as a dibbler of seed and manure, that we shall attempt to give a slight description of it. The operative part of the machine is suspended upon an iron carriage having four wheels, the two hinder ones being fast upon their axle and turning with it. On this axle is a spur-wheel, giving motion to a pinion on an intermediary axle, which carries a wheel geared into a second pinion fixed on its axis, having six cranks arranged spirally. The velocity given to the axis is such that the cranks make one revolution for every six inches of the circumference of the hind wheels, or whatever is the distance desired between dibble-holes. The radius of each crank is such that this distance shall be equal to the circumference described by one revolution. Thus the space described by every crank coincides with that passed over in the same time by the hind wheels; and as the cranks turn, during the half of a revolution, in an opposite direction to that of the wheels, the result of this compound motion is a pause or rest of short duration, at the point where the crank in its rotation commences to retrogade from the line of progress of the machine, *i. e.* at the lowest point, and when the dibbles are in the ground. The crank raises the dibbles up and down by means of connecting rods and levers, which double the vertical without increasing the horizontal motion; and in order that the point when in the ground, may be perfectly stationary, it is made the centre of motion while the machine progresses; and to enable it to retain that position for a sufficient length of time for the purpose of leaving a hole truly vertical, the dibbles move between checks in the rod which connects it with the crank, and which has a spring to restore it quickly to its proper place as it rises out of the ground. During therefore the entire time occupied in its piercing the hole and being withdrawn from the soil, the dibble retains its perpendicularity.

'By an ingenious and simple contrivance, a slow rotatory motion about its own axis is given to the dibble, by which means its point may be said to *bore* into the ground, thus assisting in the formation of the hole; and by the same action the dibble is cleared of any adhering soil, and the hole left firm and clear.

'The seed-valve consists of a cylinder, with a cavity in it of dimensions sufficient to hold one or more seeds. This cylinder is *tumbled* over, and the seed discharged into a recipient of the shape of a quadrant, from which it is *pushed out*, when the cylinder returns to its first position and takes in a fresh supply. As this motion is sudden, the seed is surely delivered, even when rather damp: when the cylinder is delivering, the quadrant is receiving, and *vice versâ*. The delivery of manure is effected by a similar apparatus only of a larger size, the valves being furnished with brushes or other means to remove the superfluity.

'The valves are connected with the dibbles in such a manner as to deposit the manure and seed in the hole last formed, whilst the dibbles are stationary in the advancing one. The dibbles bore their holes in shallow drills made by the pressure and sliding action of an iron shoe shaped like a boat, and forming a smooth furrow.

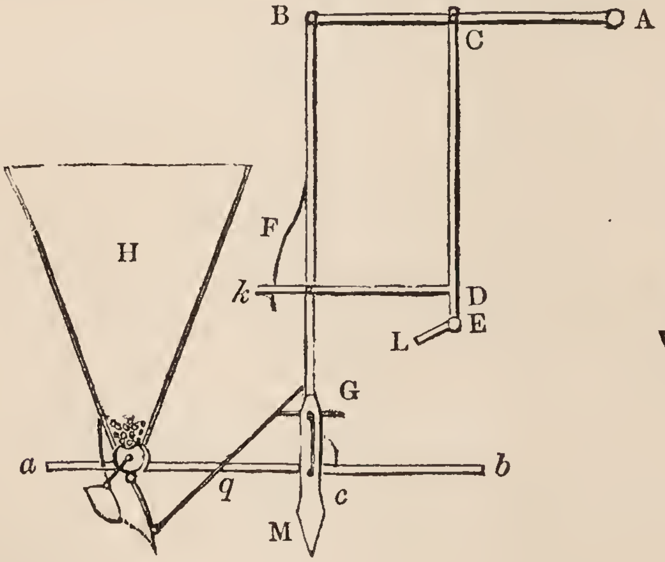
'The whole of the machinery is supported by an iron frame, one end of which rests on trunnions attached to a projecting part of the back of the carriage. It is suspended at the other end by a cross shaft carrying two pinions, working in arcs of circles fixed on the frame, so that it can be raised or depressed at pleasure, or elevated clear of the ground by one turn of a winch. At the same time, the pinion connecting the machinery with the hind wheels is put out of gear, and the whole can be moved about on the carriage. The implement is steered in a manner somewhat similar to Lord Western's drill.

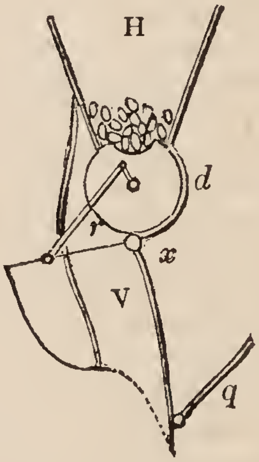
'The object of the rev. gentleman in contriving this original and singularly ingenious implement, has been to imitate the more minute and certain manipulations of the gardener; and so to adapt his machinery to the drilling and dibbling of seed upon land previously laid flat and well prepared, that every field, however extensive, should present the neatness and regularity of a highly-finished garden.

'The distinguishing peculiarities of this remarkable piece of mechanism are the arrangements for the dibbles to *bore* holes, causing them to be perpendicular and truly cylindrical, and the apparatus for giving certainty to the valves in receiving and delivering the manure.'

In order to render the above highly commendatory report of the judges more intelligible to those who have not seen this implement, we will add a slight diagram to explain the most essential parts.

ACB is a lever, whose fulcrum is at A; BG the rod of the dibble M, which turns on it by means of a socket; CDE is the rod which communicates the motion to the lever ACB, by means of the crank LE moved by the machinery. *k*D is a rod connecting the crank with the rod of the dibble, and having a slit or cheeks in which this rod moves. F is the spring which keeps the rod in its place when the dibble is out of the ground. *ab* is an iron plate with a slit or cheeks to keep the dibble from swerving from the line of the furrow made by the shoe. *c* is a pin projecting upwards from this plate and bent at its upper end. This pin meets one of four arms projecting horizontally from the shank of the dibble whenever it descends into the ground: and as it proceeds with the carriage while the dibble is at rest, it gives this a motion round its rod to the extent of a quarter of a circle. When the rod rises, it clears the arms from the pin, which, at the next descent, meets with another arm; and thus a complete revolution is effected in four descents of the dibble.





H is the vessel which contains the seed. The valve consists of a cylinder *d* with a cavity sufficient to receive the required number of seeds to be deposited in each hole, a brush to remove any superfluous seeds, and a recipient V in the form of a quadrant, in which they drop when the cylinder is suddenly turned half round on its axis. This is effected by a small crank fixed to the axis, and connected by a rod *r* with the quadrant V. The quadrant itself moves $\frac{1}{4}$ round its centre *x* by means of a rod *q* which connects it with the dibble, or with the crank when the dibble is not used; and the seed is dropped into the dibble-hole or the furrow when the quadrant is pushed back in its place. A rake and roller are attached to the implement to complete the operation.

This may give some idea of this new machine, and if it answer the expectations of the inventor, it will cause a great saving in the seed and labour of sowing, while it will deposit the seed much more regularly, and at an equal depth.

The stimulus which has been given to improvements in the implements and operations of husbandry by the establishment of the Royal Agricultural Society of

England, will greatly increase the number of useful inventions, by which all the common operations will be simplified, and the labour of the hands will be performed by machinery, wherever there is a deficiency of labourers or a great demand for them in more profitable mechanical employments, and where machinery, which works automatically and with certainty, becomes superior to manual dexterity.

STAFFORDSHIRE AGRICULTURE.—The air of this county is sharp in comparison with those which are situated to the south of it, and at the same time the county is more subject to continued rains, which make the crops later and the harvest more precarious. The quantity of rain which falls in the neighbourhood of London during the year is equal to twenty or twenty-one inches on an average, but in Staffordshire the average is about thirty-six inches. From this it is apparent that the heavy soils, and those which are situated on impervious subsoils, require very complete draining before they can be made productive, whatever may be the natural fertility of the surface. The western parts of England are in general more rainy than the eastern; and in this respect Staffordshire must be reckoned with the former. One cause of this are the high lands which traverse the country, and arrest the vapours which blow from the Atlantic. The middle and southern portions of the county are comparatively flat, and have only gently undulating hills. This portion also contains the most fertile lands, and is in the best state of cultivation.

The county is estimated to include a surface of 780,800 acres, of which in round numbers about 150,000 are in roads, wastes, and woods. The remainder, or about 630,800, are productive as arable land or pasture, in which last must be included all the parks around the habitations of noblemen and gentlemen of fortune, of whom there are a considerable number in the county. The proportion of the arable land to the pasture is nearly as five to one. Of the first, two-fifths consist of clays and heavy loams; two-fifths of gravelly and sandy loams, and one-fifth of light gravel and sand, chiefly good turnip land, but not so productive of wheat. An excellent vein of marl lies near Stafford Castle and Eccleshall. The Trent traverses a great portion of the county, and receives the tributary streams of the Dove, which is noted for its fertile banks; it also receives the waters of numerous other streams which have been already mentioned. The Severn touches the southern part of the county, and receives the waters of the Stour and Smestall. There are rich meadows on the banks of all these streams.

There are estates in Staffordshire of all sizes, from that of the rich man with a rental of 10,000*l.* per annum and more, to the small yeoman who lives by the cultivation of a spot of ground which has been the property of his forefathers for many generations. The hired farms are likewise of all sizes. Leases of farms for fourteen and twenty-one years are common.

In the Agricultural Report of the county, published in 1796, it is stated that the large farmers use broad-wheeled waggons, in which six horses, harnessed two and two, draw a load of three or four tons. The improved roads now-a-days enable the farmer to draw by means of single-horse carts upwards of six tons, or double the old load, with the same number of horses.

The ploughs commonly used in Staffordshire are those which have two unequal wheels attached to the beam, and which are also known by the name of Rutland ploughs. They can be so adjusted that they require no ploughman to hold them, excepting when they are to be turned into a fresh furrow. Double ploughs, making two furrows at once, are likewise used where the soil is very light and loose. Other modern implements, such as scarifiers, drills, and horse-hoes, are introduced on the larger farms, especially those in the hands of proprietors and cultivated by experienced bailiffs.

The mode of cropping the land, which till of late partook of the old system of getting as many crops of corn as it was thought the land would yield, and then recruiting its exhausted powers by fallows or pasturing for several years, has now in a great measure been changed for the more rational plan of giving strength first, and keeping it up by judicious management, so as to have always abundant crops and a clean surface. Where turnips and green crops can be raised, which is now the case with almost every soil which is well drained, they form the basis of the system. The use of lime and marl, which becomes every year more common in this county, improves the texture; and crushed bone and other substances, which are of easy carriage and have a powerful effect on vegetation, produce good crops of turnips, and greatly economize the manure from the farmyards.

The natural meadows along the banks of the rivers are rich and productive, being continually renovated by the depositions of fine mud in floods; but they have also the inconvenience of being sometimes flooded at a time when the grass is fit for the scythe or already cut, in which cases much loss is sustained. The Dove, which brings down from the hills many particles of calcareous matter, which it deposits where the banks are low and flat, is noted, as we observed before, for its rich meadows, which has given rise to a saying, 'rich as Dove;' and, 'In April Dove's flood is worth a king's good.' The finest natural grasses are found on its banks. When the waters of the Dove are diluted by other streams, the fertilizing effect of its floods diminishes.

There is not much land in this county devoted to the grazing of cattle, or to extensive dairies, but many fine beasts are fatted in stalls on turnips, hay, and oil-cake, chiefly for the sake of the manure. The breed most esteemed is that of the short-horns, and few others are to be met with on the principal farms. In an ox the propensity to fatten is the great desideratum, in a cow the richness and abundance of milk, and likewise the continuance of it in the cow till within a short time of calving. To unite these qualities in one animal, or in any breed, has been generally found a hopeless task: and the prudent dairyman seeks in his cows the points which denote good milkers, and not those that indicate a tendency to fatten. It is generally allowed that when the object is to rear an ox to fatten, the breed should differ from that which produces the best milch cow; no cow having yet been found to excel in both qualities of fattening readily and giving much rich milk. Experience teaches the dairyman what cows are most profitable on his pastures, and his principal care is to rear heifers from his best cows by a bull noted for producing good milkers. There are some excellent cows which it would be difficult to class with any particular breed; some have the horns long, some short, and some are without horns; but they all have deep chests, wide hips and flanks, large udders, and prominent milk-veins; a fine tail with a good brush of hair as the end, is a point usually looked for in a good cow.

The original Staffordshire sheep has been either superseded by more useful breeds, or has been changed and improved by crossing. Every breed is to be met with which is in any repute; and good farmers will vie with southern competitors in their Leicesters and South Downs. The number of sheep kept on the land under the present system is vastly greater than it was under the old, and while more corn is raised, more beef and mutton are also produced for the market.

The farm-horses in Staffordshire are active and strong, and in general well kept. The labourers are industrious, and where their employers take some pains to encourage good conduct, they are sober and honest. Whenever the farmer seems indifferent to the moral conduct of those who work for him, he can only expect to suffer in his interest from his own want of attention to this duty.

The Staffordshire hog of the old breed is coarser than the Berkshire or Essex, but much pains have been taken to introduce better pigs, and with considerable success. The Chinese and Neapolitan breeds have, as elsewhere, been of great use in producing an animal that will fat readily, with small bone and compact form.

STALL-FEEDING. The feeding of cattle in stalls for the purpose of fatting them more readily than by simple grazing, and at a time when they cannot get fat on pastures, as a regular part of the process of husbandry, is comparatively modern. In former times cattle were slaughtered in October and November, which latter, in most languages derived from the Teutonic, is called *Slaughter-month;* there being no possibility of buying fresh meat of any degree of fatness during winter, and salt meat was the food of all classes in that season. But now the process of fatting cattle goes on without interruption during the whole year, and fat beasts come as regularly to market in winter as in summer. Stall-feeding is now the principal means by which oxen and cows are rendered fit for the market.

It has been observed, in the article Soiling, that one object of that system was to save the waste of food which is occasioned by the treading of cattle in pastures, and by their choosing the sweetest grasses to the neglect of the coarser. The principal object however is to save the manure, which in the pastures goes to waste, but in the yards or stall is all preserved. In stall-feeding another object is looked to, that of increasing the substance of the animal, especially the fat; and to do this judiciously and with profit requires much experience and attention. It has been proved that animals require a certain portion of meat and drink to keep them alive, and that this quantity, in the same species, is in general in proportion to the weight of the animal. If an animal has his exact ration of food, he will continue in health, but he will not increase in weight: in this case therefore it only produces a certain portion of manure, which is not equivalent to the food consumed. If a larger quantity be given, the animal, if in health, will increase in weight, and the more food he has, within a certain limit, the faster will be this increase: but there is a point where increase stops; and if by any means the animal is induced to take more, his stomach will be deranged, and he will become diseased, and occasion loss by over-feeding. It is consequently of great importance to the stall-feeder to ascertain what is the exact quantity of food which it will be most profitable to give to a stall-fed animal. Experience alone can teach this; but some rules may be given which will enable any one who wishes to stall-feed cattle not greatly to err in his mode of feeding, and soon to find out what is the most profitable course to pursue. For this purpose it is essential that after having ascertained by experiment the quantity of food which will give the greatest increase of flesh per week on a certain weight of beasts when put up to fatten, all the food given to the cattle be carefully weighed, and no more given in any day than is needful. The quality of the food should also be attended to; for a truss of fine well-made clover, lucern, or sainfoin hay, may contain double the nourishment of another truss of coarse marsh hay. The best kind of food should always be reserved for fatting cattle. Roots are excellent helps; but roots alone are too watery, and must be corrected by dry food, such as straw cut into chaff, or good hay, and especially farinaceous food, whether it be corn ground or bruised, or oil-cake after the oil has been expressed. By a judicious mixture of food a much greater increase of flesh may be produced than by an irregular mode of feeding, however good the quality or abundant the quantity given may be. To overfeed is as unprofitable as to starve a beast, and produces similar effects. It is of great importance that the cattle should be fed with great punctuality, at certain hours during the day, and that the troughs should be cleared of all the remains of food which they do not eat at each time of feeding. Rest and sleep are great aids to digestion, and a little gentle exercise after sleep prepares the stomach for a fresh supply of food. Air also is highly conducive to health; and hence those beasts which are allowed to move about in a loose stall, or a small yard protected from the rain and wind, thrive better in general than those which are tied up. It is the practice of many good feeders to put oxen in pairs in small stalls, partly open, so that they may be in the air, or under shelter, as they prefer; and the finest oxen, if not the fattest, are prepared for the market in this way. Experience shows that all domestic animals like company, and that they are more contented and quiet when they have a companion than when they are alone.

This is the reason why they are put up in pairs. Whatever promotes the health and comfort of the animal will be most profitable to the feeder. When a beast has acquired a certain degree of fatness, it is a nice point to decide whether it would be best to send him to market or continue to feed him. This is often decided by mere caprice or fancy; but if the food has been weighed, and the weekly increase of the beast is noted, which is best done by weighing, but may nearly be guessed by measuring, it becomes a mere question in arithmetic to determine whether his increase pays for his food and attendance; if it does not, there is a loss in keeping him; and if a lean animal put in his stead would increase faster on the same food, every day he is kept there is a loss of the difference between the increase of the two. The pride of producing a wonderful animal at a fair or show may be dearly paid for, and must be put down to the account of luxuries, such as keeping hunters or racehorses.

The most profitable food for fattening cattle is, in general, the produce of the farm: the expense of all purchased food is increased by the profit of the dealer and the carriage of it. And the only compensation for this additional cost may be in increasing the manure, where the straw and roots of the farm are deficient: in that case oil-cake, or even corn, may be purchased with advantage, since by means of the manure crops may be raised which without it must fail. The stalling of cattle, as well as the fatting of pigs, is in many situations the best means of carrying the produce of the farm to market. An ox can be driven many miles, whilst the food he has consumed would not repay the carriage, and all the manure would be lost, and must be purchased at a great expense, if it can be had at all. If a farmer can feed cattle, so as to pay him a fair market-price for the food consumed, and something for the risk of accidental loss, he may be well contented to have the manure for his trouble: few stall-feeders get more than this in the long run.

SUFFOLK AGRICULTURE. The county of Suffolk is peculiarly interesting in an agricultural point of view: and, with the adjoining counties of Norfolk and Essex, it forms one of the best cultivated districts in the southern part of Great Britain.

The climate is much drier than that of the more western counties of England; but also colder in spring, when the north-easterly winds prevail. The only inconvenience arising from this is the occasional freezing of the turnips, when left on the ground; but the beneficial effects of a sharp dry air on the land, which has been ploughed up before winter, fully compensate for the occasional loss of turnips and the slow progress of early feed. The soil, although varying extremely, may be divided into three or four distinct kinds. A very rich loam, chiefly alluvial, is found in a small portion of the southern part of the county, between the Orwell and the Stour, both of which rivers form æstuaries at their junction with the sea at Harwich. This loam is not so compact as clay, nor so loose as sand, but contains a great proportion of organic matter, or whatever else constitutes a very fertile soil. Of this kind of soil it is supposed, in the Report made to the Board of Agriculture, that there may be about 46,000 acres. The next class consists of heavier loams, varying in every degree, but in general resting on an impervious soil of marl or clay, and in most situations requiring the assistance of drains to carry off superfluous water. This soil is found in the whole of the centre of the county, from the Stour to the borders of Norfolk, and is computed at 450,000 acres, being nearly half the surface of the whole county. Between the strong loam and the sea is a strip running from the north bank of the river Orwell to Yarmouth, diminishing in breadth as it stretches northward, and consisting chiefly of sand of various qualities, incumbent on a subsoil of crag, which is a loose rocky substance, composed of sand, gravel, and broken shells, partly consolidated into a kind of stone. Some of this sand is poor, and scarcely worth cultivating; but a great part of it is enriched by organic matter intimately mixed with it: this is excellent for roots, especially carrots, and bears very fine barley. In the portions which lie low, and which have at some time or other been covered with water, a very rich mud has been deposited, and has produced as rich a soil as may be desired. These rich portions however are few in comparison to the whole tract, which altogether contains about 150,000 acres. There is another tract of sand of a much inferior quality on the western extremity of the county, extending from Bury St. Edmunds to Thetford, with some better lands interspersed. This lies chiefly on a chalk bottom, and is scarcely thought worth cultivating. Where it has been improved, so as to become productive, it has been done at a very considerable expense in draining, trenching, and marling. There may be in this district about 100,000 acres of this poor sand, with 10,000 of a better quality. The last class consists of the fen-lands, which, when properly drained, become valuable; but in their natural state, soaked in water, they are of little value. The extent of fen is estimated at 30,000 acres.

The system of tillage is very uniform throughout the county. The greater part of the land is under the plough. There is now scarcely such a thing to be seen as a common field: a complete bar was formerly opposed to any improved mode of cultivation by the absurd rules and restrictions as to cropping which were established in consequence of the joint and several rights over the land, which no longer exist since the common fields have been divided and enclosed. The practice of ploughing the stubble immediately after harvest, and giving it the full benefit of the alternations of rain and frost which mark the variable climate of Great Britain and Ireland, is adopted on all kinds of soils. Wherever turnips can be profitably raised, and safely fed off with sheep, they form the basis of all rotations. Where the land is too strong and adhesive for turnips, and where sheep would do harm by their treading, and where the carts and horses would do equal damage in taking them off, a fallow is substituted: this however is not the old fallow preparatory to a crop of wheat, but it is the *long fallow*, in which the land is exposed to the influence of two winters. Barley and clover are sown in the spring of the second year, to be succeeded by wheat and beans. This long fallow has been mentioned before. [ESSEX AGRICULTURE.] We shall only observe that it was suggested by the failure of the turnips when it was attempted to sow them on very strong soils. To prevent the land being overrun with weeds, the natural concomitant of a failing crop, it was ploughed in summer and again in autumn; and as the sowing of wheat without any manure, and out of course, was not approved of, it was left to come in for barley with the lighter lands which had borne turnips. Much to the surprise of those who first adopted this plan, almost from necessity, they found that their barley was more abundant and of a better quality after the long fallow, *without manure*, than upon those fields which had borne turnips, and on which sheep had been folded. Nothing was lost therefore but the value of the turnips when fed off, which in many years is trifling. The clover ley being manured in the succeeding autumn, a good crop of wheat might be depended upon. Thus three valuable crops were reaped in four years, barley, clover, and wheat; and, where the land was in good heart, a crop of beans could be obtained, without risk, either after the clover or after the wheat, usually the latter, before another fallow, giving four crops in five years. We are not aware that this mode of cropping stiff clay lands is adopted in any part of England, except the three counties of Essex, Suffolk, and Norfolk, and perhaps in a part of Cambridgeshire adjoining these counties; but all the practical farmers who have adopted it have found their advantage in continuing the long fallow on stubborn clays.

On turnip land the four-course shift, as it is called, is universal, with some deviation as to the recurrence of clover every fourth year, a portion of the land being laid down with grass-seeds, or Italian rye-grass, or planted with beans or peas, according to the nature of the soil. The simple Norfolk rotation is however on the whole the most profitable, and by means of deep ploughing, which is but partially introduced, clover is found to succeed for a considerable period every fourth year. When any deficiency appears, recourse must be had to some substitute, so as to defer it to every sixth or eighth year. The subsoil plough is of great assistance in securing a crop of clover.

There is no part of England where the implements of husbandry are more perfect than in Suffolk, or where new implements are tried with more readiness and with less prejudice. This is owing in a great measure to the very excellent manufacturers of agricultural implements who live in the county. The competition among these men, many of whom possess great capital, tends to the detection of every defect, and ingenuity is stretched to make improvements both on the form and the durability of implements.

The ploughs almost universally used, whether with or without wheels, are of cast-iron, except the beam and the stilts; each part admits of separate renewal at a moderate expense, being cast on one pattern and attached with nuts and screws. The wheel-ploughs are preferred by the ploughmen, because they require less attention and are easier to hold; for a boy can hold a wheel-plough who would make but sorry work with the best swing-plough. The question of comparative draft, which has recently engaged much attention, it would be presumptuous to decide; but perhaps it will be found that in some cases wheels are convenient and save labour both to man and horse, while in others a good swing-plough in the hand of a skilful ploughman will plough a greater variety of land in a more complete manner, without any distress to the horses.

It would be superfluous to enumerate all the different improved instruments which are in use in a large Suffolk farm: it would comprise a complete catalogue of scufflers, scarifiers, rollers, and harrows, which assist the plough in preparing the land; of drilling-machines to deposit the seed; of threshing-machines, winnowers, hummellers, &c. to prepare the grain for the market; of machines for cutting roots or straw, or bruising oil-cake for cattle, or bones for manuring the land. Nowhere is so great a variety of farm-machines used for saving labour.

Many of the farm-buildings which have been erected of late years are not only commodious, but splendid. On the older farms there may be some deficiency, but the habitations of the farmers in general are such as many squires of the last century would not have disdained to live in; many in fact are old mansions. The barns are not so large or so numerous as they used to be before the mode of stacking corn out of doors was so generally adopted. Where a threshing-machine is erected, a single floor is sufficient for a large farm; and if the bays will hold one stack at a time, there is stowage enough for corn. The yards, on the other hand, are much increased and better arranged; where there is not sufficient shelter by walls and sheds, this is supplied by what are called *haulm-walls*. [HARVEST.] The stubble (*haulm*) which has been raked off the land after harvest, is stacked in the farmyard in such a manner as to enclose a space, leaving an opening only sufficient to admit a loaded waggon. A small square is thus enclosed, and the cattle are sheltered from cold winds. The wall is made ten or twelve feet high, and ten or twelve feet wide at the bottom. This great width is necessary to resist high winds and the rubbing of the cattle. The top is roughly thatched. When, by the rubbing of the cattle and the decay of the stubble, the wall becomes loose and unsteady, it is taken down, and spread over the farmyard as litter, and a new wall built. These haulm-walls last several years. Nowhere are stacks of corn more neatly built than in Suffolk. As many as are intended to be kept for any length of time are built on frames, called *staddles*, supported by stone or iron pillars about eighteen inches from the ground, with flat caps over the pillars to prevent the access of rats and mice. The sides of the stacks are cut smooth by a sharp knife, such as is used for cutting trusses of hay, and thus the depredations of birds are prevented, and nothing is lost. When barley is stacked, which is generally on the ground in a dry spot, it is protected by a slight coat of thatch all round down to the ground. This is fixed by means of rods and pins, and protects the outer layer of barley. It is thus not only preserved from birds, but also from the effects of the weather, and the sample has none of those discoloured grains which deteriorate the value, but is equally clear and bright with the interior of the stack, if the barley has not been hurt in the field.

The practice of dibbling corn by hand is adopted, as far as the number of hands permit; but on a large farm it is too slow an operation; the drill is therefore generally used, which will in one day sow ten acres of land. Machines for dibbling have been invented, and no less than four patents have been obtained lately for such inventions [SOWING MACHINES], but they have not yet been sufficiently tested by experience to be generally adopted.

Suffolk has but one breed of cattle which is peculiar to it. It is a polled breed, of which the cows are in great repute, and justly so. It is supposed that this breed has some relation to the Galloway and Aberdeen polled breeds; but this is mere conjecture. The cows are usually of a light red, sometimes spotted with white, of moderate size, and excellent milkers. The oxen have not been much attended to, as most of the bull-calves are fatted for the butchers or sent towards Essex and London for that purpose. Their aptitude to fatten has seldom been noticed; but the Suffolk cows, when barren, fatten well. A Suffolk cow has been known to give thirty quarts of milk per day, and of a good quality, for a considerable time after calving; but this is, no doubt, an extraordinary instance. Twenty quarts per day for three months is by no means uncommon, and sixteen may be considered as an average. This will give seven pints of butter, twenty ounces to the pint, per week—no bad produce.

The Suffolk farm-horses are noted for their docility, steadiness, and unwearied perseverance against a dead pull. In former days it was not unusual in fairs and markets to hook the traces of a horse to a ring in a post fixed into the ground. If the horse pulled till he went down on his knees, he was staunch; but if he ever refused his utmost exertions, he was despised. No better mode could be invented to spoil a good horse. The truly-bred Suffolk horses are active in their walk, which is their best pace. It is not easy for a man to keep pace with a Suffolk horse walking along the road. They step out well, and some of them can go at the rate of three miles an hour drawing a plough, and to this is owing the quantity of land usually ploughed in one day in the lighter lands of Suffolk and Norfolk. The usual mode is, as in Scotland, in two yokings, resting two or three hours between, in summer. The defect of the Suffolk horses, if it be any for a farm-horse, is to have rather coarse heads and very wide hips. Some of them are exceptions, and show fine proportions; and many a Suffolk mare has been put to a thorough-bred horse, and produced very fine foals for the carriage or the chase. But those who would try this cross should be very careful to select mares with fine heads, good shoulders, and not a falling croup. In spite of all precautions, the old points will come out, and occasionally spoil a very promising foal, even at the third or fourth generation.

Suffolk pigs are perhaps, on the whole, the most profitable breed in England. They are well-shaped, short-legged, mostly white, with short upright ears, and the porkers of this breed are excellent. It may be distinguished from the Essex breed by being better covered with hair, and from the Norfolk by having smaller ears set more nearly together. It is difficult to trace the crosses of so prolific an animal as a pig; but while the Essex have evidently much Neapolitan blood, the Suffolk seem to have more Chinese. Both crosses being excellent, it is useless to dispute the pre-eminence. The Suffolk pig is not so delicate in constitution as the Essex, and is therefore decidedly the best poor man's pig.

Suffolk has no indigenous breed of sheep; the South Down and a cross of this breed with the Leicester and Cotswold are very common. The cross between the South Down and Norfolk is increasing in reputation. The horns of the Norfolk sheep, and his rambling propensities, have been changed, and a quiet polled breed is the result. They are well shaped; and the mutton, if old enough, is excellent.

They are getting more and more into favour.

SURREY AGRICULTURE. — The climate of this county is favourable for corn and grass. Along the Thames and the other rivers of the county the air is soft and mild: where the ground rises into barren gravelly hills, or lies on the range of chalk which divides the county in a direction from north-east to south-west, from Croydon to Farnham, it is keener, and the winds are more boisterous. But hardy plants and robust constitutions are rather invigorated by it than otherwise. The soil varies greatly in different districts. The richest is that which lies along the banks of the rivers, consisting chiefly of a deep alluvial loam. On this soil, in the neighbourhood of London, are some of those extremely productive and highly cultivated market-gardens which supply the metropolis with fruit and vegetables. The immense quantity of manure which is annually laid on the land so occupied, and the deep trenching and digging which are repeated at short intervals, have converted the whole surface, to the depth of three feet or more, into a rich black vegetable mould. On this soil are raised the best and earliest culinary vegetables, which so rapidly succeed each other, that five or six different crops are sometimes gathered from the same ground in one year. There is another naturally rich black soil, which appears in small detached portions along the foot of the chalk hills. Although this soil requires great attention in its tillage, owing to its hardening in dry weather and being very soft and muddy when wet, it produces fine crops of wheat. The quantity of this soil however is small. The next in fertility is a hazel loam, with a considerable portion of calcareous earth in its composition, which is found on the northern side of the hills about Cobham, Ripley, Woking, and Horshill: the well-known hop-grounds in the neighbourhood of Farnham are mostly on a similar soil.

The most extensive tract is that of the Weald clay, which is a soil with a smaller mixture of silicious sand than most clays. This weald extends into Sussex and Kent, and occupies most of the southern parts of the county. Some of it when ploughed rises in continuous strips, and is turned over in solid masses as if it were soap. In its natural state this soil is of little value, and can only be rendered productive by very complete draining, and by correcting the tenacity by chalk or gravel, where they can be found at hand, which however is seldom the case. The Weald is generally low and flat; where it rises into hills the soil is more fertile. In the northern portion of the county extending towards Hampshire is a large tract of sandy loam of various qualities, some of which remains to this day in the state of heath and commons. There are some sandy loams of a better quality between the barren soil known by the name of Bagshot sand and the chalk hills, as about Esher, Dorking, and Reigate: about Godalming it becomes of a very good quality, resting upon a sandstone. The poorer sands rest chiefly upon a yellow ferruginous gravel.

The tops of the chalk hills are either covered with a short pasture, as downs, or, where the soil is deeper over the chalk, it is mostly under the plough.

Surrey is a favourite county for the residence of men of fortune. It possesses many beautiful sites, and the views from some of the hills are very extensive, such as Richmond Hill, St. Ann's, Cooper's Hill, and Leith Hill. The villas within a short distance from London are very numerous, but few of them have more than a small quantity of pasture-land and pleasure-ground attached to them. Within a certain distance from London the larger properties have been mostly subdivided, and their value greatly increased from the competition of purchasers. Where land is held as an investment or inheritance, the rent is low, and the farms are not often let so as to encourage the tenant to lay out any capital. Where the tenure is from year to year, there is no security to the tenant in case of the death or failure of the landlord; and he is only restricted in his mode of cultivation by the custom of the country, than which nothing can be more vague. Two or even three white crops in succession are no infringement of the custom in some places, provided the land has been fallowed and manured. Where leases are granted, the conditions are often absurd and contrary to the principles of all improved husbandry, if they are not even contradictory and impossible. The consequence is that farmers who are of the old school continue a slovenly unprofitable system, by which they get a bare livelihood, and the land remains unimproved, if not deteriorated. There are proprietors, however, who are more alive to their own interests; who assist their tenants in draining, marling, or chalking their land; and who, by granting leases on fair terms, get respectable tenants with sufficient capital to cultivate the land properly. Most of the farms are smaller than is consistent with a wealthy tenantry. Provided a man has a sufficient capital, he can cultivate 500 acres as easily as 200, and can afford to use better and more improved implements. A lower profit per acre will remunerate him; while the small farmer requires all his profits to maintain his family. Till within a few years the poor-rates swallowed up a great portion of the rent; and the tenants, having their labour partly paid from the rates, were not inclined to lessen a burden which fell chiefly on the landlord, who was in consequence obliged to lower the rent. In some parishes the rates fully equalled the rent, and yet the aggregate was not too high for the tenant to pay. Land worth twenty shillings per acre let at ten shillings, the rates making ten shillings more; but the tenant had a profit on the rates by the reduction of wages, and the whole loss fell on the landlord. The removal of this abuse, and the commutation of the tithes, will tend greatly to the benefit of both landlord and tenant, and introduce a better system of cultivation.

The implements of husbandry used in Surrey vary extremely on different farms. Some adhere to the old clumsy Kentish wheel-plough, others adopt the more modern and improved forms. The strong turn-wrest plough, with four or six horses, may be very well adapted to break up rough ground full of stones and roots, although the modern subsoil-plough would do this with much less power; but for ploughing land which is already in cultivation a lighter instrument is greatly preferable. A turn-wrest plough might be constructed as light as any swing-plough; and where the subsoil is porous, and the land can be laid flat, no plough does its work better than a good light turn-wrest plough; and as the system of under-draining extends so will no doubt this implement. The skim-coulter, so generally used in ploughing leys, which turns in the surface and buries it, was invented by Ducket, at Esher in this county. On all the light soils swing-ploughs with a skim-coulter are universally used. The mole-plough is used as a substitute for under-draining, chiefly on meadows. Where the subsoil is a tenacious clay of a uniform texture, this instrument is efficacious; but where a variety occurs in the soil, it is only a temporary remedy against excess of moisture. The bore made by the plough is soon choked, even if the moles do not work in it; and wherever this is the case, a springy spot is formed. On the light soils the seed is generally put in with a drilling-machine; on the heavier it is mostly sown broadcast. Dibbling is not much practised, except in the market-gardens.

On the larger farms thrashing-mills are common; but as the farms are mostly small and the labourers abundant, the flail is the usual instrument of thrashing.

The system of fallowing to clean the land, and to "sweeten" it, as old farmers say, is almost generally adopted on the heavy soils: in fact there is no time in autumn or spring to clean land, which is then usually in a wet state; and the only crop that can be profitably raised in the fallow year is tares to cut up for horses or cattle. On the best soils this may take place on half the land usually fallowed; and if the tares are cut early in summer, or, which is better, fed off with sheep, the land may be got clean and in good order for wheat-sowing by what is called a bastard fallow. It is seldom that the season will allow of cleaning clay-land before spring sowing. Fallows are therefore occasionally indispensable in such soils. The course of crops differs on the different soils. On all light soils the Norfolk four years' course is generally adopted, with occasional modifications. On the chalk sainfoin is sown with advantage, and broken up after five or six years. On the lands which are too wet for turnips to be fed off, the common course is—fallow, wheat, beans or clover, and oats. The long fallow for barley, which is so common in Essex and Suffolk, is almost unknown in Surrey: barley is seldom sown, except on the better light loams, where the Norfolk course is adopted. On the Weald clay the usual rotation is—fallow, wheat, clover, and oats, which is probably as good as any. Many farmers plant or drill beans on half the land which has borne wheat, and sow the other half with clover. If they give a half-dressing of manure for their beans, this is the best and most profitable course, as the clover then only recurs every eighth year. But this cannot be done without stall-feeding cattle on corn or oil-cake, or fattening pigs on the beans, where manure cannot be purchased; for the produce of the farm is mostly carried to market, and without oil-cake the straw of the wheat and oats would produce an insufficient portion of manure for the land, and that of a very inferior quality. The beans are carefully hoed by hand, where there is any pretension to good farming. Some old-fashioned farmers, especially among the small occupiers, adhere to the old course of fallow, wheat, oats, laying on all the manure they can make on the fallow for the wheat. The appearance of the land will readily show where this is the case, without asking a question; and the poverty of the farmer proves how unprofitable it is to the tenant, as well as the landlord. On the chalk soils, where there is a strong reddish clay, which the chalky subsoil prevents from being wet, turnips are added to the foregoing course, or rather the Norfolk course alternates with it, thus: fallow well ploughed and stirred and folded with sheep; wheat, beans, oats, turnips dunged, barley, clover, oats or wheat, according to the fertility of the land. Peas are sometimes substituted for the beans, and tares made to precede the oats. There is no great fault to be found with this system, provided attention be paid to have a sufficient quantity of manure, either from sheep fed on the downs and folded at night on the land, or by the stall-feeding of cattle. Without the advantage of the downs to feed the sheep, or grass-land attached to the farm, a proper quantity of manure could not be made. On all the good sandy loams the Norfolk course is universal, with the same variations which are found useful in that county. [NORFOLK AGRICULTURE.]

The poor barren sands have been rendered productive in some spots by trenching and judicious planting. Where the iron pan, as it is here called, or the moorband, which is an almost invariable concomitant of heath, is broken through, trees thrive well; where this is not done, planting is generally a dead loss. In the midst of the most desolate heaths in the county a cottage is sometimes erected by some poor man, with the consent of his parish, or by tacit acquiescence, with a garden in which fruit-trees grow and good vegetables are produced. This has been chiefly effected by deep digging, manuring with scrapings from roads and the ashes of the turf which serves for fuel mixed with the manure of the pig, which is littered with coarse grass or fern from the common. This shows that the soil is not irreclaimable; and it requires only the labour and care which are stimulated by necessity to convert these barren heaths into productive land. They are by no means so unpromising as some of the Dutch and Flemish heaths, which are now in full cultivation. [BARREN LAND; FLANDERS AGRICULTURE.]

We have mentioned sainfoin as a plant grown with great advantage on the chalky soils of this county, where it thrives well, and leaves the soil improved by the decomposition of its roots. It is usually sown with barley, as is the practice with clover, with this difference, that the land is ploughed deeper in order to loosen the chalky subsoil, into which the roots of the sainfoin strike to some depth. Some farmers sow trefoil at the same time; but the best farmers do not approve of this. The sainfoin alone will cover all the ground, and give a greater weight of fodder, whether green or made into hay, than the mixture; and the trefoil seems to act as a weed to the sainfoin, and to check its growth. As grass and weeds are great enemies to sainfoin, the land should be quite clean when the barley is sown —as it should be at all events—that the sainfoin may choke the weeds and keep possession of the surface. It will bear a long continuance of dry weather without looking sickly, which is owing to the depth to which the roots grow. Sainfoin may also be sown before winter, if the soil is prepared; and in that case it is well to give it the whole surface of the land without any other crop. In the course of its continuance, which may be five or six years or more, the loss of the corn crop will be fully compensated. In order to have a fine sainfoin hay, it should be sown thick, to increase the number of stems without causing them to be too strong and woody, which would be the case if they had much room to grow in. A thick crop also keeps down the weeds. The proper quantity of seed is four or five bushels per acre. When the sainfoin is sown to stand for seed, a different mode of management must be adopted. In this case the plants cannot be too strong, and they should stand in rows a foot apart, and the intervals be hoed, as with beans; but in this case the plant will not be allowed to remain long in the land, and it will be better to cut it young for green food in the succeeding years than to make it into hay.

When sainfoin has been cut several years, it may be invigorated by top-dressing. The liquid manure, which is collected in tanks, and consists of the urine of stalled beasts and the drainings of dunghills, is the most effective recruiter of the soil. In Switzerland, where sainfoin is grown abundantly on the chalky slopes at the foot of the Jura Mountains, the inhabitants carry this liquid in flattened conical tubs slung on their backs, the wide part rising above their head; and distribute it by pouring it over the sides of the tub, right and left, by a peculiar stoop and jerk. One would suppose this to be a very slow and laborious process; but where carts could not well go, owing to the nature of the surface, it is the readiest means of carrying manure, and it is only mentioned here to prove how valuable a top-dressing it is found to be. It is in a very concentrated state, and usually put on in rainy weather, or in the evening, to prevent burning. If a cartload of rotten dung were well washed in as much water as will fill a large cart, it would be found to have imparted all its richness to the water and left only insoluble fibres of straw behind. This quantity of liquid manure is as easy of carriage as a cartload of dung, and would invigorate a much greater extent of ground than if the solid manure were carted on and allowed to dissipate, in a great measure, before it is washed in by the rains. This is only anticipating what the rain will do less effectually, and avoiding the disappointment caused by dry weather.

Ashes are likewise a useful top-dressing for sainfoin. Peat and wood ashes are the best, no doubt, but coal-ashes, which may be obtained in larger quantities, have also a very good effect when well sifted from cinders. Gypsum has been used with advantage; but it is not yet known how it acts. In some soils its effects are scarcely perceptible, in others it seems to do wonders. Top-dressing not only produces a greater crop, but keeps the plant in vigour for a longer period when it begins to get thin; and as the expense of cultivation is confined to this top-dressing, the longer the field can be made to produce a good crop before it is broken up again, the greater the profit. To say that sainfoin does not exhaust the soil at all, may perhaps not be warranted by theory or practice; but as it draws its nourishment chiefly from the chalky subsoil, and the gramineæ derive theirs mostly from the surface, it is reasonable to conclude that sainfoin exhausts this latter less, in proportion to the produce, than any other of the plants usually cultivated, lucern not excepted; for lucern requires a good friable soil to thrive in, and to enable it to last as many years as the sainfoin.

In making sainfoin hay great attention must be paid to the weather. It has a hollow stem, which in long continuance of wet weather becomes filled with water: in this case the hay can be seldom carried without danger of its becoming musty in the stack and being entirely spoiled.

In very dry climates there is no fear on this account; but in our moist climate this is a serious evil. The situations in Surrey where the sainfoin grows best are also most open and exposed to the winds. If the proper time be chosen for making sainfoin into hay, which is when the flower is first beginning to fade, and the swarth be often turned without any tedding or spreading about, and soon made into small cocks, there will be no great danger of the stems being soaked with wet, even by very heavy showers. It must be left till quite free from moisture or sap before it is stacked, or it will become mouldy or heat dangerously, as the water or the sap prevails. Well got up sainfoin hay is nearly equal in value to clover hay, and much more nutritious than the best meadow hay. It is especially good for fast-working horses, as it affects the wind less than clover. Lucern and sainfoin hay are generally considered on a par, when equally well made. But if the most is to be made of the crop of either of these plants, they must be cut green, just as the flower opens, and given to horses and cattle in that state. One of the greatest enemies to the duration of a field of sainfoin is the oat-grass, which insinuates itself and ultimately thins the plant so much as to force the farmer to plough it up. This should be anticipated, and the ground ploughed and cleaned before the weeds have gained the mastery; for in that case it is difficult to eradicate them.

When a field of sainfoin is broken up, it should not be sown again for at least as many years as the sainfoin has lasted, or it will probably fail of giving such a crop as will keep down the weeds. There are some exceptions, at least it is so stated in books, where the land, being thoroughly cleaned by fallowing, sainfoin has been sown again immediately with success. But we would not recommend the practice: it is better to choose another field, and let the sainfoin go the round of the chalky fields in succession: the crops which come after it will be all the better. These remarks may be taken as supplementary to what is said in the article Sainfoin.

The hop-gardens of Surrey are about Farnham. The greater value of Farnham hops in the market is probably owing partly to the soil in which they grow being peculiarly suited to this plant, and partly to the greater care with which it is cultivated. The greater price obtained for the best Farnham hops is the stimulus to the exertions of the growers. For a detail of the culture and management, see Hops.

The wealds of Surrey were, till within a comparatively modern date, one continued forest (*Wald*, in German), and were gradually cleared and cultivated, as timber was in request and land was wanted to raise corn, which, within little more than a century, the wealds did not produce in sufficient supply for the inhabitants, although the population was small. At present the woods have been greatly thinned, and the process of grubbing has gone on most rapidly. It has been found that the underwood, with a few trees interspersed, if properly taken care of, is more profitable than an open wood of thriving oaks, which have a slow growth and give a distant return, while the coppice is turned into money every ten, twelve, or fourteen years. Hence the management of underwood has been well attended to. The woods are kept dry on the surface by numerous open drains in the tenacious clay. The shoots have been plashed and laid down to take root where there appears any vacancy, and the woods have been carefully fenced from cattle and other trespassers. The best underwood consists of quick-growing trees, as ash, elder, sallow, and willow. The oak and chestnut are more precarious, although more valuable when in perfection. The coppice, if of any extent, is cut and sold by the proprietor or his agent. When it is included in a lease of a farm, from twelve to sixteen shillings per acre is an average yearly rent. When the lease is for twenty-one years, the farmer is induced to cut the coppice twice, although it does not produce so much as it would at twelve or fourteen years' growth, even allowing for the rent of the surplus years. It is therefore always preferable for the landlord to keep the coppices in hand.

The new plantations which are made are either merely ornamental, near the seats of proprietors, or are on the barren sandy soil, as mentioned before.

In the heaths and poor sands furze is often abundant, and gives some return, when cut and tied in faggots for heating bakers' ovens, and for the use of brickmakers and lime-burners. In some places it has been sown for this purpose, and has produced a good return at a small expense. A gallon of seed is sown per acre after the land has been cleared of heath and ploughed deep. The subsoil must be dry, or the furze will not thrive. In the first year it may be mown, and the tops, bruised in a mill, are very good food for horses and cows. It may be cut afterwards every three years and tied up into bundles. An acre will produce from 2000 to 3000 bundles, worth six shillings a hundred delivered. This is a good return from such poor land.

There is no peculiar breed of cattle in Surrey. There is not much good grazing-land, and the beasts that are fatted or kept for milch-cows are of all the breeds which are usually met with. Short-horn and Alderney cows, and crosses between them, are very common in the pastures adjoining gentlemen's seats. There was a small herd of pure Ayrshire cows kept at Esher by the late R. Oswald, Esq., and a cross between these and the Alderney, which were very beautiful, and gave excellent cream and butter. They were sold and dispersed through the neighbourhood, and the breed will probably not be kept pure. Beasts of all breeds are fatted at the distilleries near London. Oxen for draught are very seldom met with, horses being almost universally employed for farm-labour.

There was once a peculiar breed of heath sheep, which had a small fleece of fine wool, and very delicate flesh when fatted. The meat was well known by the name of Bagshot mutton. There is only a small remnant of this breed left, as many of the heaths and commons have been divided, although not cultivated, and the sheep have no longer their former wild and extensive range. The farmers are partial to the South-Down sheep, and some prefer crosses between these and the Leicester or the Cotswold, which give a heavier fleece and larger carcass. They also bear folding on the exposed hills. Several farmers about Ewell, Esher, and Walton, and towards Guildford, rear house-lambs for the London market. The ewes are invariably of the Dorsetshire breed, which lamb early. They are well fed and closely housed, and the sucking lambs are treated in a manner very similar to calves fattening for the butcher. The great object is to get them fit for the market as early as possible in the season.

The pigs are principally of the Berkshire breed. There was formerly a very large breed at Rudgwick in this county. The hogs, some of which gave carcasses of forty and fifty score when fat, vied with oxen for weight. But these enormous animals took a long time to fatten, consumed a large quantity of food, and the bacon was not so readily disposed of as of the smaller sorts. This is a sufficient reason for their being less valued.

TANK, a reservoir for water or other fluids. The name is sometimes applied to large open receptacles, or ponds, formed by excavating the ground and disposing the removed earth in the form of banks to retain the water; but the tanks which will here be especially treated of, are the smaller covered reservoirs used to collect and retain water and liquid manure for domestic and agricultural purposes.

The importance of collecting rain-water for domestic purposes, especially in districts where springs are deficient or lie at a great depth, has been much overlooked in this country. Waistell, in his 'Designs for Agricultural Buildings,' urges the importance of placing spouts round all the buildings of a farm to collect the rain-water which falls upon them into a tank or tanks; observing that, besides the value of the supply of water thus obtained, the buildings will be benefited by the walls and foundations being kept drier than when the water from the roof is suffered to fall upon them. He states that the quantity of water that falls annually upon every hundred superficial feet or square of building (in Great Britain) is about 1400 imperial gallons. If therefore the external surfaces of roofs were adapted to the collection of the rain-water which falls upon them, and means were provided for conveying it to covered tanks, in which it might be preserved from evaporation, and kept free from any admixture of impurities, almost every house might be readily and cheaply supplied with a quantity of wholesome water sufficient for the ordinary wants of its inhabitants. The extensive roofs of churches and other public buildings might be employed in like way to collect water for the supply of ponds or tanks for public use. In some cases even the drainage of lands might also be made available, as the water may be submitted to any required process of filtration before it is allowed to enter the tank.

Tanks or cisterns to hold water for domestic purposes may be conveniently situated beneath the surface of the ground, so that, being paved over, they occupy no valuable space. They are formed of stone slabs grooved into each other and set in cement; of Welsh slate; of large paving-tiles bedded in cement; of brick-work; of plates of cast-iron; or of thick wooden planks, protected by charring and pitching, or lined with sheet-lead. The brick tanks described by Waistell are circular, the sides being built like a well, with bottoms of an inverted dome-shape, of very slight convexity. The top is also dome-shaped, and has an opening in the centre large enough to receive a man, in order that the tank may be thoroughly cleaned out when necessary. This opening, which may be upon the surface of the ground, or a little above it, should be covered with an oak flap pierced with a number of holes, or with an iron grating. The depth and width of the tank should, it is stated, be nearly equal. If necessary, a smaller brick chamber may be constructed alongside of the tank, in which the water may be filtered through gravel, sand, charcoal, &c. before entering it. It is recommended to make the opening by which water enters the tank near the top. Brick tanks of this description may be rendered water-tight by laying the inner course of bricks in cement, and plastering the whole of the inside with the same to the thickness of about three-quarters of an inch. To enable them without injury to bear the great weight of water when nearly full, the earth should be rammed closely round the brick-work, and it should be allowed to settle thoroughly before any great quantity of water is admitted. Loudon, in his ‘Encyclopædia of Cottage, Farm, and Villa Architecture,’ describes another kind of brick tank, contrived to save expense in construction, by adopting a figure of maximum capacity and minimum surface. When the tank is large, it is proposed to adopt the spherical form; and when of less than five or six feet in diameter, that of a short vertical cylinder with hemispherical ends. By puddling with clay round about the tank, the necessity for the use of Roman cement is avoided.

In the forty-ninth volume of the ‘Transactions’ of the Society of Arts (part ii., p. 12), is a communication from Mrs. Davies Gilbert respecting a cheap method of constructing tanks for receiving water from the roofs of cottages, which has been successfully practised at Eastbourn, in Sussex. A reservoir having been dug seven feet deep and about the same wide, the bottom was covered with flints laid in liquid mortar composed of one measure of grey chalk lime (made of chalk marl) well beaten up with three measures of clean sea-sand. The side walls were built of the same materials, leaving a small space at the back of the wall, which space was filled up with the same sort of grout or liquid mortar. The tank was then roofed over with a dome, formed, without any centring, of smaller flints well bedded in mortar. A hole was left in the centre, and covered with a hood, within which was hung a pulley with a rope and bucket for drawing water from the tank. This account was published in 1833, and in 1837 an article appeared in the ‘Labourers’ Friend Magazine,’ in which it is stated that such tanks had been found very useful during three dry summers. One, less than seven feet deep and wide, had supplied two labourers’ families during that time, while most of the springs in the neighbourhood were dry. This paper describes a brick tank with sloping sides, the diameter at the base being smaller than at the top, and with a dome-shaped top formed by making each row of bricks project one-third beyond that immediately below it, and balancing the weight by filling up the back with earth as the work proceeds. One of the flint tanks, constructed as above described, at the Eastbourn workhouse, is twenty-three feet deep and eleven feet wide. Only ninety bushels of lime were allowed for its construction, including two coats of plaster, and the work was executed at ten shillings per hundred square feet.

In the article last quoted from, it is observed that a current of air has been supposed to promote the purity of the water preserved in tanks. If so, it may be easily provided for. Where the prevailing winds do not blow soot and leaves upon the roof, the water is found to remain good, even for drinking, without clearing out the rubbish more than once a year.

In addition to tanks for water, every farm-yard should have one to collect the liquid portion of the manure, which is washed by the rain through the refuse litter, and also the urine of the stalled cattle. Though not yet generally adopted in England, in France, Germany, and especially in Belgium such tanks are considered as necessary to a farm as any of its most common buildings. They are usually constructed of an oblong shape, of brick well cemented, with one or more divisions, and capable of containing at least ten times as many hogsheads as there are heads of cattle on the farm. They are vaulted over, having a small aperture, in which a pump is placed, sufficient to allow a man occasionally to clear out the sediment, when the liquid has been pumped up. The best shape to contain a large quantity in the smallest space would be like those before described; but they cannot conveniently be made sufficiently large, and a cubical form, or rather that of several cubes in succession, is preferred. A tank for a farm of 200 acres of arable land should be 15 feet wide, 15 deep, and 45 long, giving 3 cubes of 15 feet, or a cavity capable of containing upwards of 10,000 cubic feet of liquid. In this tank the urine is diluted with water to prevent too rapid decomposition, and also to retain the ammonia which is formed; for which purpose gypsum and sulphate of copper are sometimes put into the tanks.

If the soil be not sandy, clay will answer, instead of mortar, to connect the brick-work, and a plastering of lime or cement will be sufficient to keep out the worms: but in very porous soils the bottom and sides must be puddled, to keep in the liquid; and it may be advantageous to build the walls in cement altogether. The liquid from the yards and stables is carried into the tank by a main drain constructed of brick or stone, and which receives a number of smaller drains from every part of the yards and cattle-sheds. Thus the litter in the yard is always dry, and none of the richness of the manure is lost by evaporation.

Sometimes the tank is vaulted like a cellar under the cow-house and stables, which are washed out twice every day, and all the dung and water are swept into a cess-pool communicating with the tank. Thus a very diluted, but rich liquid soon fills the first division of the tank: a sluice is then shut, and the next washings run into a second division, and when that is full, into a third. In the meantime the contents of the first tank have undergone a certain fermentation, by which the caustic ammonia first evolved has become mild and impregnates the water. It is then in a fit state to be carried on the land in tubs or water-carts. When properly diluted, it accelerates vegetation in a surprising degree; but if put on fresh, it burns the grass or any vegetable it touches, because the ammonia is in a caustic state. If a cow drop her urine in a field in a hot summer's day, all the grass it has touched becomes yellow and is burned up: but if the same happen in rainy weather, the spot soon becomes very green, and the grass luxuriant; because, in this case, the urine is amply diluted and its caustic nature corrected. Those who live near gas-works may collect the ammoniacal gas-water in a tank, and, by the addition of sulphuric acid in very small quantities, they may produce a very fertilising liquid, which will stimulate vegetation, and be a very good manure.

The necessary concomitant of a tank, whether for water or manure, is a water-cart, that is, a large cask put upon wheels to bring water from some distance. When there are no means of bringing water in pipes, a water-cart is quite indispensable. It is simply a cask placed on the frame of a cart, with a plug-hole in the end or lower part, from which the water may be let out by a cock, or drop on a flat board or into a bucket with holes, so as to spread it about. The plug-hole is shut by a valve inside, which can be opened by means of a string, the pressure of the liquid keeping it close to the plug-hole.

Many of the artificial manures, of which a number have been lately proposed, would make excellent liquids by merely mixing them with water in a tank, and allowing a certain degree of fermentation to take place. Thus nothing is lost, and all volatile substances are taken up by the water. The soluble portions are dissolved and the earthy matters diffused, so as to be more equally spread over the land. If it be true that the ammonia found in some plants is chiefly derived from the very small portion discovered in rain-water, it follows that a scarcely perceptible impregnation with this salt may have most powerful effects on vegetation.

When a farm-yard is situated on a hill, and there are fields or pastures on a lower level, at no great distance from it, the liquid from the tank may be conducted by channels lined with clay, having small sluices to direct the streams to any particular field. It may thus be made to irrigate temporarily a considerable surface, which it will greatly enrich. It may be led into the common furrows between the lands or stitches in ploughed land, and allowed to soak in them, and then it can be spread with the earth of the furrow, by means of broad shovels, over the growing crops, and will greatly invigorate them. This species of irrigation is common in Lombardy, where much ingenuity is shown in the manner in which water is made to flow in small rivulets between the rows of growing vegetables. The water here is supplied by streams, but the same method would distribute the tank-liquor with great effect. A very small quantity of this liquor, allowed to flow into the main feeder of a water-meadow, will soon prove how great effects are produced by impregnations which are scarcely perceptible by chemical analysis.

Small as the experience has hitherto been in this country of the advantages of liquid-manure tanks, it has sufficiently proved their use to induce every man who constructs a farm-yard and erects buildings to take in the tank as an essential part of his plan; and even if it only collected the refuse fluids which are allowed to run off in common sewers from most houses, it would soon repay the cost of its construction, while it rendered the ditches in the neighbourhood less subject to noxious emanations from the corrupted matter which now flows into them.

TARES are a most important green crop in the improved systems of agriculture, especially on heavy soils, where they thrive best. When sown in autumn, with a small sprinkling of wheat or rye, they cover the ground in spring, and supply abundance of fodder in summer. A good crop of tares is fully equal in value, if not superior, to one of red clover: it comes off the ground in sufficient time to give the land a hasty summer tillage, which is so useful in destroying weeds, and to allow turnips to be sown in the same season. They smother annual weeds if the crop is plentiful, which should always be secured by an abundant manuring; thus they are a good substitute for a summer fallow in heavy soils, and amply repay the labour and manure bestowed upon them.

There are many species and varieties of tares; but that which is found the best adapted for agricultural purposes is the common tare (Vicia sativa), of which there are two principal varieties, very slightly differing in appearance, one of which is hardy, and will stand the severest winters: the other is more tender, and is therefore only sown in spring; but it has the advantage of vegetating more rapidly, so that spring tares sown in March will be fit to cut within a fortnight or three weeks after those which were sown in autumn. By sowing them at regular intervals from September to May, a succession of green tares in perfection, that is, in bloom, or when the pods are formed, may be cut for several months, from May to October. A prudent farmer arranges his crops so that he shall have artificial green food for his horses and cattle at least six months in the year, by having tares fit to cut between the first and second cut of clover. When there are more tares than is absolutely required for this purpose, and the weather permits, they make excellent hay; or, if the weather is not favourable, they are cut and given to sheep, which are folded on the portion already cut. It is an advantage to have portable racks for this purpose, that the fodder may not be trod under foot and wasted; or the tares may be placed between hurdles, tied two and two, which form extemporaneous racks. It is prudent to raise sufficient seed for another year; but a crop of seed-tares raised for sale is seldom profitable, as they greatly exhaust the soil: and the price varies so much in different seasons, that it becomes too much of a speculation for a farmer. The difficulty in distinguishing the seed of the winter tare from the spring variety is so great, that it should either be raised at home, or only purchased from neighbours or from the most respectable seedsmen. It is a common practice with dealers to mix the seeds of the winter tares, after the time of sowing is past, with spring tares, which are in request at a later period. The inconvenience of this is, that they do not vegetate equally, and consequently the winter tare is not in bloom when the spring tare is fit for the scythe. Foreign tares, which are imported in large quantities, are often the growth of southern climates, and will not stand the winter; or they have been raised from seed sown in spring, so as to be really spring tares. The difference is probably more owing to habit than to any real botanical distinction between them. When spring tares are sown in autumn, instead of winter tares, they may occasionally stand the frost, if not very severe; but, in general, they rot on the ground and never recover; whereas the real hardy winter tares, whose vegetation is slower, seem insensible to the severest frosts.

In the early part of summer green rye and tares, mixed, are sold at a great price in large towns, for horses which have worked hard and been highly fed in winter. They act as a gentle laxative, and cool the blood: near London, where every produce is forced with an abundance of manure, tares are often fit to cut early in May, and the land is immediately ploughed and planted with potatoes, or sown with mangel-wurzel or ruta baga, which come off in September or October, in time for wheat-sowing. Thus two very profitable crops are raised during the time that the land, according to the old system, would have been fallow; and at the same time it is left as clean, by careful hoeing, as the best fallow would have made it.

There are a great many species of tares or vetches, for the terms are synonymous, many of which have been proposed to be introduced into general cultivation; but none seem, on the whole, to be so well adapted to our climate as the common tare: some have biennial and some perennial roots. The *Vicia biennis* has a strong stem and large leaves, and grows four or five feet high; but it is not so succulent as the common sort. It might, perhaps, by cultivation and early cutting, become a useful early fodder, and it may be worth while to make some experiments with it. There are several species of tares which grow wild in bushes and hedges; but they have never been cultivated in the fields, perhaps from the difficulty in collecting the seeds, which shed as they are ripe. Of these, the *Vicia craca* appears most deserving of attention. It bears its blue flower on stems or spikes longer than the leaves, which are downy. It is very common in France among wheat; and, although a decided weed there, it is not much dreaded by the peasants, as it improves the fodder greatly. It has the appearance of great luxuriance in its growth, where it meets with a proper support. If it were mixed with some plants with a strong stem, such as the Bokhara clover (Melilotus arborea altissima), which itself affords much fodder, it might probably be cultivated to great advantage.

In the south of France there is a white perennial vetch or tare, called *Vicia pisiformis*, which is cultivated for its white seeds, of which soups are made, as with the pea and lentil. It grows in very light soils; and, although indigenous to a southern climate, it is said not to be impatient of frost. It has been called by some the Canadian lentil, or the white tare.

We shall only notice one more of the wild tares, which is an annual; it is called the yellow tare (*Vicia lutea*). It grows in stony soils and among bushes, is very branching, and rises from one to two feet high. From some experiments made by the Agricultural Society of Versailles several years ago, it would appear that this tare might be cultivated with great advantage, and is even superior to the common sort, because it can be cut two or three times during the summer, and affords a very good pasture in winter, which does not stop its vegetation: it will even bloom in a mild winter. Although short, it is so thick upon the ground, that its first cut is as heavy as that of the common tare, which is seldom worth cutting a second time.

Tares should be sown on land which is well pulverised. If after wheat, the stubble should be ploughed in with a deep furrow after a powerful scarifier has gone over the land several times to loosen it: five or six cart-loads of good farm-yard dung should be ploughed in. The tares should be drilled or dibbled, and the surface well harrowed. The intervals should be hoed early in spring: this will accelerate the growth, and ensure a complete covering of the ground. As soon as the tares show the flower, they may be cut daily till the pods are fully formed; after this, any which remain uncut should be made into hay or given to sheep; for if the seeds are allowed to swell, the ground will be much exhausted. Another piece should be ready to cut by this time, and thus there may be a succession of tares and broad clover from May to November. Tares may be sown as late as August, on a barley or rye stubble, for sheep-feed early in winter, or to be ploughed in to rot in the ground where beans and peas are intended to be sown early in spring: this is perhaps the cheapest mode of manuring the land, the only expense being the seed; for the tillage is necessary at all events. In light soils, tares and buckwheat sown together immediately after barley or rye harvest, will produce a considerable crop of vegetable matter, which may be ploughed in in November. In favourable seasons, wheat may be sown immediately after, without fearing the effect of two white crops following each other; for the tares and buckwheat intervening, by their shade, and the two ploughings of the ground, one when they are sown, and the second when they are ploughed in, will entirely destroy all weeds, and give to the soil that improvement which will enable it to bear as good a crop of wheat as it would have done had it been sown the year after on a clover lay. Clover, which could not be sown with the barley, from the foul state of the land, may be sown among the wheat in the next spring, when it is hoed for the second time. This is held out as a hint to show how an accidental interruption in a rotation may be remedied without any loss of crop or great deviation. As no rule is without exception, so no rotation can always be strictly adhered to; and those crops which admit of being sown at different times of the year are of the greatest use as substitutes for others which could not be conveniently sown without materially altering the succession of crops. In the common course of cultivation of heavy soils, where occasional fallows are necessary to clean the land, one-half of the land which requires fallowing may be sown with tares; and thus the clean unproductive summer fallow will only return at every second rotation. If the tares have been manured, or if they are fed off with sheep folded upon the land, the wheat or other crop which is sown after them will be as good as on a clean fallow, or after a good crop of clover. This alone would make tares a valuable crop; and they may be compared in their effect on heavy lands to turnips on lighter soils.

The seeds of the tare are occasionally ground into meal and made into bread. It is a very poor food; and when there is more seed than can be profitably disposed of, it may be given to pigs: but poultry, especially pigeons, are very fond of it. When given to horses, the seeds of tares are found very heating; and although they produce a fine glossy coat, they are not to be recommended for this purpose.

TEAM. Nothing is of greater importance in the management of a farm than the cattle which perform the necessary work in ploughing and other operations on the soil, in drawing manure to the land, and carrying the produce to market. It is evident that the smaller the expense of the team which does the requisite work in proper time, the greater the profit of the farmer, and every saving in this part of the expense of cultivation is so much added to the clear gain. Wherever the land is only partially cultivated, and a portion of it remains in coarse pasture, which costs little or nothing to the occupier, or where extensive open commons afford cheap food for oxen, these last are naturally employed in farm labour. If four oxen do only the work of two horses, they are maintained at a much smaller expense, and, after working for two or three years, their value is improved for the purpose of fattening for the butcher. The necessary gear is much less expensive, especially where the old yoke is still in use, whether across the neck or the horns. In fact for a poor man who has only a few acres of land, and who is situated near a waste or common, oxen, and even cows and heifers, are by far the most economical team. Many writers on agriculture, who in general have more theoretical than practical knowledge of husbandry, have maintained the general superiority of an ox-team over that composed of horses, and have given calculations which appear clearly to establish that point. But, on the other side, it may be observed, that wherever arable land is the chief object of the farmer's attention, and the tillage of the soil is brought to any degree of perfection, there oxen are never seen at work, but have been invariably superseded by active horses.

It has been urged that at Windsor Park, where it may be supposed that the farms in which George III. took so much interest were conducted by the most experienced agriculturists, a considerable team of oxen was kept, and did most of the work, even to the carrying on the roads. This is a confirmation of what we have observed before. The oxen feed on the grass of an extensive park, the value of which is not brought to account. They are very lightly worked, and fatten well after two or three years' work; but if a rent had to be paid for their pasture, or if it were calculated how many young oxen and heifers or sheep could have been kept on the pasture consumed by the oxen, and the profit of these were set against the value of the work done, it would probably appear that there was no great economy in the ox-team compared with the horses. In Switzerland, which is tolerably advanced in its agriculture, oxen are very generally used for the work of the farm; but there the system of stall-feeding is universal, and having a considerable portion of grass-land, which can be irrigated by the streams from the mountains, they cut the coarse long grass produced there for their cows and oxen; and this food is more congenial to their nature than to horses, which do not thrive on coarse watery grass, and require hay and corn nearly all the year round. But where there is less grass-land and more artificial grass, such as lucern, sainfoin, and clover, which is the case in all extensive farms, there horses are chiefly used, this food being suited to their constitution. Not to enter further into the comparative advantage of oxen and horses, we shall turn our attention to the most profitable management of the latter, which now almost universally compose the farmer's team.

The choice of the horses for a farm is of great importance. It may be very satisfactory to a rich farmer to see fine large well-fed horses in his waggon, moving along as if they followed a procession, with bright harness ornamented with shining brass. This is a luxury like that of the rich man's coach-horses, and as such is very natural and innocent. It is the pride of many a wealthy yeoman, and we would not curtail his pleasure or despise his taste; but as a matter of profit or loss the case is very different: a fat horse does little work, no more than a fat coachman. Horses to be in working condition should be muscular and active. The great heavy cart-horse may, for a moment, be capable of a greater exertion at a dead pull, his weight assisting him; but in a long day the thin active horse will do with ease what would sicken, if not kill, his heavy companion. Horses about fifteen hands high, with short legs and broad chests, such as the Suffolk punches, which walk as fast as an ordinary man, or the active Scotch horses, which have more blood and will readily trot with a moderate load, are the most economical for farm-work. A pair of such horses will draw a load in a cart sixteen miles and return, or plough a Scotch acre of land, equal to one acre and a quarter imperial measure, in ten working hours, having a rest of two hours; while the heavy slow South-country horses could not walk the distance in the time without being over-driven. This is more than the average work; but in the busy time of the year it is a great advantage to have horses which can, with good feeding, work longer and faster without suffering in their health. The carriers on the roads, who live entirely by the work of their horses, know how to choose them and how to feed them to the greatest advantage, and, without over-working them, to make them do as much as is consistent with their health. If hard work is the cause of some diseases in horses, comparative indolence causes many more. Where horses are sluggish, the men soon become so likewise. To see a waggon with four strong horses returning empty, at the rate of two miles in the hour, with two men, or at least a man and a boy, lying lazily in it, is a sure sign that the work on the farm to which they belong is done at the same rate. A single-horse cart, or a light spring waggon with two horses, driven by a man or boy with reins and a whip, and trotting at the rate of five miles an hour, is a perfect contrast to this, and no doubt the owner has his work done much more expeditiously, and consequently at a cheaper rate. The stage-coach proprietors have generally very light four-wheeled carriages to carry their corn from their chief stations to places where they keep horses, and they often carry as heavy loads as a farmer's waggon does when carrying corn to market; yet the two horses in the light carriage trot with their load, and the three or four heavy horses of the farmer move at the rate of two miles and a half in the hour at most, both going and returning. It is evident that there is a waste of time and power here, which is so much lost. Horses half-bred between a cart-mare and a blood-horse are reared by some spirited farmers, and if they are more delicate and suceptible of cold than the common cart-horses, they have many advantages: sometimes they inherit so much courage and vigour from their sire, that they become valuable as carriage-horses or hunters, and well repay the expense incurred in rearing them; and at all events they are superior to any others for the work of the farm, and are in general docile and tractable. The only inconvenience arises from their spirit. When any sudden obstruction arises in ploughing, such as a considerable root of a tree or a large stone, they make violent exertions, and sometimes break the ploughs or other implements. In this respect oxen are more phlegmatic, and stop when the collar presses on them; so that in breaking up rough commons or newly cleared woods oxen may be preferred. This is almost the only case where spirit and courage are not an advantage.

With respect to the food of farm-horses, as we observed before, a great saving may be effected by a judicious use of many vegetables and roots which are easily raised on arable land. Various modes of preparing the food have been recommended, such as steeping corn till it sprouts, baking it into bread, or mixing it with boiled roots. All these may have their advantage where economy is the object; but, with the exception of baked bread made of rye, barley, and oats, and slightly leavened, which is perhaps the best food which can be given to slow-working horses, there is nothing so congenial to the healthy stomach of a horse as good hay and dry oats, or beans bruised in a mill and mixed with cut chaff. They require no cooking to be fully digested, and the digestive power of the horse will extract all the nourishment which they contain. But there are cheaper fodders than hay and corn, especially in summer, when they can be given fresh and green. Tares, clover, lucern, and sainfoin, cut as they are wanted, will keep a horse in health and working condition with little or no corn, and at a comparatively trifling expense: carrots are peculiarly relished by horses, and are very wholesome; and Swedish turnips, or ruta baga, given raw in moderate quantities, make their skins shine, and thus prove that they tend to keep them in condition. Every prudent farmer takes care to have a sufficient supply of these cheaper substitutes for hay and corn, keeping these last as a reserve and auxiliary to the former. In a prize essay of the Highland and Agricultural Society, on the comparative advantages of raw and boiled grain as food for farm-horses, the author adduces some experiments, which lead to the conclusion that there is no advantage in boiling grain, but rather the contrary. The cost of keep of a horse per day on different food has been given as follows :—

10 lbs. of straw cut into chaff .	1*d.*
10 lbs. of oats, at 3*s.* per bushel .	9
16 lbs. of turnips, at 10*s.* per ton	1
Expense of cutting	1½
	1*s.* 0½

or—

16 lbs. of hay, at 3*s.* 6*d.* per cwt.	6*d.*
5 lbs. of oats, at 3*s.* per bushel .	4½
16 lbs. of turnips, at 10*s.* per ton	1
	11½

or—

28 lbs. of steamed turnips . . .	3½
7 lbs. of coals, at 1*s.* per bushel	1
Expense of steaming	½
16 lbs. of straw, at 1*l.* per ton .	1½
	6½

This last appears the most economical food, but steamed turnips and straw only would probably not keep a horse in good working condition, and it is not said how long the experiment was continued, nor whether the horses thus fed lost weight. The food is also valued at a low rate.

It is evident that if farm-horses can be kept in condition for 6½*d.* a day, which is not 4*s.* a week, while on hay and oats, in the common mode of feeding, they will cost more than double that sum, the saving in a year would amount to nearly 10*l.* on each horse; and as every twenty-five acres of a farm of moderately light land will require one horse for its cultivation, there will be a saving of 8*s.* per acre, probably half the rent, and more than half the profit. However this may be, there is no doubt that it is of great importance to ascertain what is, on the whole, the best and cheapest mode of feeding farm-horses; and without entering into minute calculations, it will be found that various artificial grasses may be made to succeed each other by successive sowings so regularly that the horses shall be kept for six months of the year entirely on succulent green food, which will enable them to do all the necessary work, and keep them in good health and condition. Thus with the help of carrots, potatoes, and ruta baga, a great saving of hay and oats may be effected in winter, and these crops will take up much less land for their production than hay and oats, and exhaust the soil less: if we except potatoes, which are more profitably used as human food or to fatten pigs.

The example of tradesmen and manufacturers who keep horses, and cut all the hay which they use into chaff, mixing it with oats, may be good for a farmer to follow where hay is scarce and beans a good price: but otherwise it is fully as economical to give the hay in racks, provided no more be given at once than a horse will eat up entirely, and a certain ration be allowed for each horse, which experience has shown to be sufficient. In the cavalry, where great attention is paid to economy, the horses have their rations of hay, oats, and straw according to the exercise they take, or the fatigue they are exposed to: so likewise it should be with a farmer's team. In the old mode of feeding horses with as much hay as they would eat, and two bushels of oats for each horse per week, during at least nine months in the year, and giving them tares or artificial grasses between spring sowing and harvest, when there was less to be done, the expense of a horse was much greater than most farmers could now afford; and more land was devoted to the keep of the team than was necessary. The following is the calculation of the cost of the keep of a horse in this way :—

	£	s.
32 weeks, at 2 bushels of oats per week, at 3*s.* 6*d.* per bushel	11	4
20 weeks, at 1 bushel of oats per week, at 3*s.* 6*d.* per bushel	3	10
Tares, 20 weeks, at 3*s.* ($\frac{1}{12}$ of an acre) per week . . .	3	0
Hay, 32 weeks, $1\frac{1}{2}$ cwt. per week, at 4*s.* per cwt. . .	9	12
Shoeing	0	15
Farrier	0	5
Total	£28	6

The hay and oats are at high prices, but at all events a horse cannot be kept in this way under 10*s.* per week. They are then, however, in excellent condition, and able to work ten hours per day in summer and eight in winter.

On poor land, where gorse or furze grows readily, a very cheap food is obtained by bruising or crushing the young shoots of the gorse to destroy the sharp spines, which injure the mouths of the cattle. Horses reared in large commons are often seen beating the gorse with their feet, and then eating it greedily: instinct here teaches them to prepare their own food; and, if they have a sufficient quantity of it, they get fat and in good condition.

It is of great importance to a person about to hire a farm to know exactly what number of horses will be required for its proper cultivation; and this depends upon many circumstances, which must all be taken into consideration, and which will make a very material difference, often as much as half the rent of the land. He is to consider the situation of the farm-buildings, especially the stalls and cattle-yards, where the manure is to be made, with respect to their distance from the fields; the state of the roads and the access to the fields; the distance of a good market-town, and whether the fields lie in a ring-fence or are scattered. A farm of good light loam will require one horse for every twenty-five acres for its cultivation, with an additional one for every 200 acres; that is, nine horses for 200 acres. The additional horse should be lighter and more active than the rest, for the farmer to ride on and to drive in a light cart: yet it should be capable of supplying the place of any of the others in case of illness or accident, or when extra work is required, as in harvest or seed time. The larger the farm, or rather the fields, the fewer horses are required in proportion to its size, because much time is lost in turning the plough where the furrow is short; and ploughing is always the principal work of the team. If more than two horses are required to plough the ground, the soil must be very compact and heavy; and if this is not compensated by greater fertility, the expense of the horses will much reduce the profit of the farmer. It is the custom in some farms for each ploughman to have the charge of his own horses: but it is far better to make the feeding and cleaning of horses the business of regular servants, who should sleep in or near the stables, and rise very early, so that the horses may be fed and ready to go to work as soon as the ploughman comes. When a man has been eight or ten hours holding a plough, he is not so capable of cleaning and rubbing the horses as one who has only had light work in the day. The horse-keepers can prepare manure, make composts, cut hay and straw into chaff for the horses, mow tares or other green food, or hoe the crops in the season while the horses are at work, and the last thing before they lie down at night should be to give the horses their proper ration of hay and see that their beds are comfortable and everything in proper order in the stables: good grooming is of as great use to a horse as good feeding, and without it they will never be in perfect working condition. The harness should always be cleaned and oiled, and hung up in a separate place, not, as is too commonly done, hung up behind the horses in the stables. There should be no unnecessary ornaments, but strength and simplicity should be studied. The weight and size of the collars is in many places absurd: they cannot be too light, provided they are of sufficient strength. The work in the field when the days are long should be divided so as to give the horses at least two hours' rest, during which they should be fed with bread or corn. When the fields are near the stables, the horses may be brought home, but a portable manger is easily carried into the field, such as is used at the inns on the roads where carriers stop to bait. In winter it may be as well to finish the day's work with only an interval of half an hour. The time in summer should be from 5 in the morning till 10, and from 2 till 7 if the weather is very warm, resting four hours; or from 6 till 11, and from 1 till 6, resting two hours. In winter the time is from 7 till 3, resting half an hour or an hour between 11 and 12. With good feeding and grooming this is by no means too hard work when the work requires to be carried on briskly. The heavier and lighter kind of work should be so arranged that when horses have worked hard for a day or two, they may have one or two days of lighter work. In most parts of England the pace of the horses and their daily work are much less than in Scotland: two horses should plough an acre a day or more, on an average, but few farmers can get much more accomplished than three-quarters of an acre, if they plough a good depth or break up clover or grass lays. In the light sands of Norfolk and Lincolnshire they go over much ground; but there the furrows are wide and shallow, and the horses might easily trot with the plough if the ploughman could keep up with them. In Flanders such land is ploughed with one horse only, and the work is well done. There is yet much room for improvement in the use and management of the team on most farms in England.

TEAZLE (*Dipsacus Fullonum*) is a plant which grows wild in the hedges, but an improved variety is carefully cultivated in those districts of England where cloth is manufactured. It is used for the purpose of forming a species of brush with which the finer hairs of the woollen fabric are drawn to the surface, where they produce what is usually called the *nap* of the cloth. The teazle has a fine hooked awn, which very readily insinuates itself into the woollen web, and draws out with it some of the fine fibres of the wool; these are afterwards shorn smooth, and leave the cloth with the fine velvet-like nap which is its peculiar appearance. A further account of the operation of teazling, in the woollen manufacture, is given in Ure's 'Philosophy of Manufactures,' p. 192.

Teazles will grow in any soil; but they grow strongest and best in a stiff loam. They require the soil to be in good heart, and are supposed to exhaust it much; but no great portion of manure is required to obtain a good crop. Like all the tribe of thistles, they grow best on ground newly turned up from grass which has lain for some time, and the same ground will not again produce them of so good a quality till after a considerable interval. The wild teazle which grows in hedges appears at first sight to be the same as the cultivated variety; but it is of no use to the cloth-worker from the weakness of the awns, which break off, instead of drawing the wool out of the surface of the web.

The growing of teazles is a peculiar trade, and a kind of speculation. The teazle-grower hires a piece of ground suited to his purpose from the farmer for two years, and pays a considerable rent. If the ground is broken up from grass, it is ploughed as deep as the staple of the soil permits, and as early as possible, if before winter so much the better: the ground is laid in narrow stitches, on which the seed is drilled in April, in rows from 12 to 18 inches apart: moisture is necessary to make the seed germinate. As soon as the plants appear, they are thinned out, and the intervals carefully hoed and weeded. During the summer, the ground is several times dug, or *spaded*, as it is called, to a considerable depth, with very narrow and long spades; this greatly invigorates the plants. In November, some plants may be transplanted from where they stand too thick, to the places were they have failed. They should stand about a foot apart in the rows. During the ensuing spring, the cultivation is repeated, and earth is drawn up to the plants, but without burying the heart. They soon begin to push up their stems, and are fit to be cut in July, just when the blossom has fallen. As they do not come to proper maturity at the same time, several successive gatherings are made. They are cut with a sharp knife about nine inches below the head, and tied in small bundles or handfuls; thick gloves are very necessary in this operation. They must be carried under cover before night, as the rains or heavy dews would injure them. When the sun shines, they are exposed to dry in the same manner as is done with onion-seed, and they are never packed close until they are perfectly dry. When drying they are usually hung on poles, so that the air may circulate between the bundles. The bundles are afterwards opened, and the teazles sorted into kings, middlings, and scrubs, according to their size; 9000 kings or 20,000 middlings make a pack. The scrubs or refuse are of little value: sometimes the grower places a certain number in a flat bundle by means of cleft sticks, in which the stems are held and the heads spread out like a fan. In this state they are not only more easily packed, but more readily fixed to the circumference of the drum, on which they form a continuous card, which brushes the cloth as it is drawn along while the drum revolves.

Teazles are a very precarious crop; sometimes they produce a very great profit, and at other times a serious loss. Care and cultivation lessen the chances of failure greatly: but the price also fluctuates so much that it is an uncertain speculation, resembling in this respect the cultivation of hops. Hence it is undertaken by men who are prepared for the event, and who make the profits of one year repay the loss of another.

Several attempts have been made to substitute artificial teazles, formed of hooks of very fine and elastic steel wire; and at one time there was so much appearance of success, as to cause the cultivation of teazles to be neglected: but it was soon found that the wires tore the fine fibres of the wool, especially where there were knots in the thread, whereas the hooks of the teazles gave way, and either bent or broke off before the fibre of the wool was injured. The card made of natural teazles was found far superior to the artificial substitutes, and for a time the price of teazles rose to an extravagant height from their scarcity, while some time before they were quite unsaleable. A quantity of teazles which was sold at one time in Berkshire for 5*l.*, being thought perfectly useless, was taken into Gloucestershire, and there produced the next year 150*l.* The grower was dead, and they were sold by his executors for what they would fetch. This was exactly at a time when the artificial cards were given up, and no teazles were to be had. A good crop of teazles is about 10 or 12 packs on an acre: this is sometimes exceeded, but more often it fails by one-half, and a total failure is not uncommon. The price may average six or even seven pounds a pack, so that a good crop is worth more than the land it grew on. The expenses, however, are great, and, taking all the chances, it is a crop which, except in very particular situations and circumstances, is not suited to the regular farmer, who should never speculate to any extent.

Although teazles are said to exhaust the ground much, yet from the continual stirring of the soil they render it very fit to grow other crops, provided a proper quantity of manure is used: thus very good crops of wheat have been obtained after a crop of teazles. Every piece of fine broad-cloth requires from 1500 to 2000 teazles to bring out the proper nap, after which they are useless, the hooks being mostly broken off or worn out. This causes a considerable demand for them in the neighbourhood of cloth manufactories, as in Wilts, Gloucestershire, and Somersetshire. In the new tariff the duty is 3*d.* per thousand, whether from foreign countries or British possessions.

THATCH is a covering of straw, rushes, or reeds, as a substitute for tiles or slates, for houses, barns, and principally for sheds for cattle. The increase of agricultural produce on a farm makes the stacking of corn out-of-doors a matter of necessity as well as convenience. The temporary thatching of these stacks, as well as of hay-ricks, has made it necessary that some of the regular servants of the farm should be capable of thatching in a neat and substantial manner, that there may be no delay from want of a regular thatcher. We will first describe the mode of thatching hay-ricks and corn-stacks, as the simplest.

The rick or stack having been formed into a proper shape, either with a roof slanting from a ridge, or conical, and ending in a central point, the straw is prepared by moistening it, that it may more easily bend without breaking. It is then forked up in a loose heap, the straws lying in every direction, and somewhat matted. Portions are now drawn out from this heap in handfuls, which lays the straws again in a more parallel order: these are placed in a forked stick, which will hold several of these bundles or handfuls, and are thus carried to the thatcher on the top of the rick or stack. He seizes a handful, and bending one end into a kind of noose, he inserts this into the hay or straw near the bottom of the roof, at one end if it be a square roof, or at any convenient part if it be a round one. He presses down the straw which he has thus inserted to about half its length, in order to form the eaves, which extend a little beyond the lower part of the roof. When he has thus laid several handfuls side by side so as to cover about a yard in width, that is, as far as he can conveniently reach without moving his ladder, he begins another row a little above the place where he begun, so that the lower end of the straw now inserted may cover the upper part of the first row, as tiles do each other. Thus he proceeds upwards till he comes to the upper ridge of the roof, or to the point of the cone in a round stack. In the latter case the covering diminishes to a point, so as to form a triangle. The ladder is now shifted a yard to one side, and the same operation is performed, care being taken that each fresh handful put on shall be interwoven with that which lies beside it, so that no water can possibly pass between them. Thus the work proceeds till the roof is completed, and it only remains to secure the upper ridge in a square stack, or the point of the cone in a round one. In the first case the highest layer of straw is made to extend beyond the ridge on both sides, and the ends are brought together and stand up like the bristles on a hog. A rope of straw has been prepared, and many small rods, about two feet long, and cut sharp at the point: these are inserted just below the ridge, in a line with it, and about a foot apart; one end of the straw rope is inserted into the stack, and twisted firmly round the projecting end of the first rod; it is then wound once round the next rod, and so on the whole length of the ridge: this is done on both sides. The straws which form the ridge are now cut with shears horizontally, to give it a neat finish, and at each end a kind of ornament is usually made by winding a straw rope round a handful of the projecting straw, forming a kind of knot or bow, according to the taste of the thatcher. Rods and straw ropes twisted round them are inserted near the edge of the slanting side and all along the eaves, which prevent the wind from blowing off the thatch.

The only difference in the thatch of a round rick is, that it is brought to one point, where it is tied with straw rope wound round it, and formed into a kind of bow; the rods are inserted a little below in a circle, and a straw rope twisted round them, and likewise around the circular eaves. Barley is generally put into square stacks, and wheat in round ones. When the outside is neatly trimmed and cut smooth, so that no birds can lodge in it, wheat may be kept for years, without danger of injury or loss, much better than in a barn, or even in a granary.

In thatching sheds and buildings which are to last many years, the straw is prepared in the same manner, but the ends of the handfuls, as they are put on a lathed roof, are kept down by means of long rods, which are tied to the laths of the roof by means of strong tar twine. A much thicker coat of straw is put on; and rye-straw, which has a solid stem, is preferred, as more lasting, and less liable to be filled with water than hollow straw. Instead of straw ropes, split willow is used, and the rods which are inserted are much nearer each other and more carefully secured. As this kind of thatching is a peculiar trade, it requires a regular apprenticeship to be master of it. The thatching of temporary ricks may be done from mere description, and a very little practice will enable any one to protect his stacks sufficiently by a thatched covering.

Thatching is usually paid by the square of 100 square feet. The thatcher takes a line and throws it over the stack; if it is square, the ends are pushed under the eaves on each side, to allow for the trimming, &c., and this length is multiplied by the length of the eaves, with the same allowance at the ends. The price varies from 2*s.* to 7*s.* or 8*s.* per square, according to the work. Round stacks are measured by taking the circumference at the eaves, multiplied by one-third of the slant of the cone, with a similar allowance.

THISTLE. The thistle, with its strong prickly leaves and stem, establishes itself in the meadows and corn-fields, when it is not very carefully eradicated, and occupies the place of more useful plants. There are many varieties of the thistle, some of which are not destitute of elegance when in full blossom. Considered as a weed in our fields, our principal object is to eradicate it, which, in consequence of the ready dispersion of the seeds by the wind, is not easily done, as a slovenly farmer may seed the whole country around; and where the thistles are not eradicated from the hedges and sides of the roads and paths, it is impossible to destroy them entirely: wherever the soil is newly turned up, especially when it is of a nature where wheat will grow well, thistles invariably arise: hence the saying of the blind man in choosing land, 'Tie me to a thistle.'

Those crops which are usually hoed can readily be cleared of thistles; but where the seed is sown broadcast, the labour of weeding them out is much greater. If they are not extracted with the root, they will soon grow again with redoubled vigour. In a moist season they may be pulled up by means of a wooden or iron forceps, which grasps them strongly near the crown of the root, and, as it has a projection which serves as a fulcrum, a pressure on the handles draws the root out when they are brought together. When a field has been long infested with thistles, the best way of clearing it is to watch when the thistle is in full bloom and the seed is just forming; if it be then cut off at the root, it will die. Thus in two years a field may be entirely cleared of thistles.

It is chiefly in arable land that thistles are most troublesome. In pastures it is sufficient to eradicate them once, and to permit none to grow along the hedges and ditches. The seed does not readily vegetate, unless it finds a loose soil; and little birds are so fond of it, that they will leave none that is not covered with earth, especially in the beginning of winter. In some countries there are penalties inflicted on those who allow thistles to remain in their hedges or along the high road which borders their land; and a man may complain to a magistrate of a neighbour who will not destroy the thistles on his land, when the delinquent will be admonished or fined, as the case may require. Such a law would be very advantageous in many parts of the country, where no attention is ever paid to the weeds which grow in the hedges or in waste spots.

THRASHING. The separation of the grain from the ear in corn has always been one of the most laborious operations on a farm. Where the quantity grown is merely sufficient to supply food for the cultivators of the soil, the simplest methods answer the purpose sufficiently. The corn taken by handfuls may be beaten on a piece of wood or a table, and by repeatedly turning the straw the whole of the grain may be readily beaten out. This mode of thrashing is still adopted in order to obtain the finest and ripest grains for seed; but then the straw is afterwards thrashed over again with the flail, which is the instrument most generally adopted for thrashing corn. It is needless to describe this instrument, which is so generally known. It requires some practice to use it effectually and to avoid accidents to the thrasher himself or the bystanders. The flail being swung round the head, the beating part of it is made to fall horizontally on the straw which is spread on the thrashing-floor; and, by inserting this part occasionally under the straw, it is turned over and a fresh portion is brought up to be beaten. This is done without losing the stroke or time when several men are thrashing together. If it were not that thrashing is mostly done in winter, when no out-door work could well be done, few labourers would submit to its toil; and it is very difficult to ensure the entire separation of the grain without great vigilance and attention on the part of the master or overseer. If the labour is paid by the day, much time is usually lost; and if it be by the quantity of grain thrashed or by the number of sheaves, there is a great temptation for the men to hurry over the work, as more grain is thrashed out at first when the ears are full than afterwards.

Where the corn is thrashed out immediately after harvest, to be put into a granary, as is the case in those countries where extensive tracts of rich land are sown with corn two or three times without much tillage or manuring, and then left to be recruited by several years' rest and pasture, the most common practice is to level a portion of a field, and laying the corn in the straw in a large circle, to drive oxen and horses over it till it is all trodden out. This is the method alluded to in Scripture, and can only take place where the climate is serene and dry. Till ingenuity had produced machines to supersede the flail, this was the only instrument in use. The first idea of a machine for thrashing was that of imitating the motion of the flail, but so much depends on the eye of the thrasher, that no mechanism could well imitate the motion of his arms. This was consequently given up, and an imitation of the rubbing of the grains from the ears between the hands, combined with the beaters of a flax-dressing-machine, gradually produced the present improved thrashing-machine.

Without a figure it would be difficult to describe the different parts and motions of a thrashing-machine. They are however now so common, that it will suffice to give the general principal of action, and to mention some of the latest improvements in it. A rapid motion is given to a hollow cylinder round a horizontal axis; on the outer surface there are projecting ribs parallel to the axis at equal distances from each other; the width of these is from two to six inches. Around half the cylinder is a case the inner surface of which is lined with plates of cast-iron grooved in the direction of the axis. The ribs or beaters come quite close to these grooves, so that an ear of wheat or other corn cannot well pass between them without being flattened. The sheaves of corn, having been untied, are spread on a slanting table, and in some machines are drawn in between two iron rollers, of which one is plain and the other fluted. The motion of these rollers is slow, while that of the cylinder or drum is very rapid. The beaters act on the straw as it comes through the rollers, and beat out most of the corn; but what remains is carried in between the beaters and the fluted case, and when it has made half a revolution all the grain has been beaten and rubbed out. It falls on a sieve, which lets the grain through, but retains the straw, which is raked off by hand or by circular rakes moved by the machinery. Some of the best implement-makers in England have found the two rollers superfluous, and have accordingly dispensed with them. The straw is at once subjected to the beaters, and the machine may be fed more or less rapidly according to circumstances. It requires a little more attention in the person who feeds the machine, but more work is done and some power saved. The great perfection of a thrashing-machine is to rub out every grain and to break the straw as little as possible; the larger the scale of the machine the better it does this. Hand-machines have been made on the same principle, but they do not effect any saving in the expense, requiring many men to produce the effect of one horse. The great advantage of hand-machines is that men and women can be employed to thrash who could not use the flail skilfully. Movable thrashing-machines are very generally in use in England where farms are small. They are often the property of an industrious labourer or mechanic, who undertakes to superintend the work, the farmer finding horses and men. Thus he goes from farm to farm and earns his livelihood from a small capital laid out in the purchase of a machine. The price of thrashing in this way is about half of what is usually paid for thrashing with the flail; it is more rapidly done, there is less chance of pilfering, and fewer grains remain in the straw.

On very large farms it has been found economical to erect a steam-engine to work the thrashing-machine, chaff-cutter, and other domestic implements. Where coals are cheap there is a great saving. A steam-engine costs little to keep it in order. When not working, the interest on the original price is the only loss, whereas horses must be fed whether they work or not. The price of steam-engines is so much reduced and their construction so simplified, that they will probably soon form an essential part of the implements on every farm.

There are some thrashing-machines on a new principle which are said to work well. The drum is furnished with rows of spikes, and similar spikes are fixed into the cover, which work in the intervals between the first. The corn in the straw is drawn in by the spikes on the drum, which revolves rapidly, and the ears being beaten in all directions by the fixed and the revolving spikes, the grain falls out of the ear and is collected below. Such a machine was exhibited at the Agricultural Meeting at Cambridge in 1840, but it seemed to break the straw more, and to be more apt to clog, than the machines in general use. These will no doubt be made gradually simpler and cheaper, till they entirely supersede the flail, even in very small farms.

TILLAGE, applied to arable land, is the stirring and preparing the surface of the soil, so as to render it fit for the vegetation of the seeds committed to it: its object also is the destruction of noxious weeds.

The whole art of cultivation consists in tillage and manuring, and the profit of the husbandman depends on the perfection of the tillage and the economy of labour in producing the effect. A defect in tillage will cause a great deficiency in the crops in ordinary years. To ensure good crops, the soil should be in such a state that the rains and dews may readily be diffused through it, without giving it a wet appearance, or evaporating too rapidly. It requires great knowledge and experience to give any particular soil the exact portion of tillage which is suited to it. A fine garden-tilth, as it is called, is the most perfect for light soils which have been long cultivated and manured; when they can be brought to such a state that after continued rains the surface dries without forming a crust, and crumbles of its own accord, the tillage has been good; and the deeper this soil is stirred, the more it will produce: but where clay abounds in the soil, which in dry weather can be readily pulverised by crushing the dry clods, and be reduced to the finest powder, too much tillage may do more harm than good. The fine clay is soon converted into mud at the surface by the least rain, because it is not sufficiently porous to let the water through it; it dries into a hard crust, which effectually precludes the access of air, and consequently stops the vegetation of the seed. It is only by abundant manuring with organic matter, especially of animal origin, that this natural tendency in clays to cohere can be overcome; and until this is effected it is best to stir clay soils as deep as possible by means of subsoil-ploughs, but they should not be pulverised so that the water cannot run down between the lumps and clods, and especially the surface should be left in such a state of roughness that heavy rains cannot cover it with a coat of mud. The clods which are left on the surface imbibe the moisture more gradually, and in drying fall to pieces, by which the young plants are invigorated, and, as it were, moulded up. This is particularly the case in winter after a frost, as all clay-land farmers are well aware. It is very easily ascertained whether a soil will bear much tillage or not. It is only necessary to try some of it in a large pot or box; make the surface very fine by breaking the clods, then water it abundantly, and let it dry in the sun; if a crust is formed in drying, that soil will not bear too much harrowing and pulverising, and should be left in a moderately rough state after sowing or drilling the seed; but if, after it dries, the surface is loose and porous, then the finer the tillage the better the seed will vegetate. The whole depends on the ready admission of air or its exclusion. When grass-seeds are sown, the surface should be well pulverised; but this cannot be safely done if the soil is apt to run together when much rain falls soon after the seed is sown. Some plants, like beans, will force their way through a very hard surface; but small seeds are too weak to do so, and their growth is entirely stopped by the least crust on the surface. Besides the preparatory tillage of the soil before sowing the seed, there is a great advantage in the stirring of it as the plants are growing. On this depends all the merit of the row culture for every kind of plant, especially those which have esculent roots or extensive foliage, and which are chiefly cultivated for the sustenance of cattle. The effect of deep tillage is here most remarkable. If rows of turnips or cabbages be sown at such a distance that a small plough or other stirring implement can be used between them, and the intervals be stirred more or less, and at different depths, it will be found that the deeper and more frequent the tillage, until the foliage covers the whole interval or the bulbs swell to a great size, the heavier and more abundant the produce will be. It is worth while to try the experiment:—Sow Swedish turnips or mangel-wurzel in rows three feet apart: let some of the rows be merely kept clear of weeds by surface-hoeing, and the plants be thinned out to the distance of a foot apart: let other intervals be stirred to different depths; some three inches, some six inches, and some nine inches or more. The result will be, that the first rows will appear to have been sown much too far from each other, not half the ground being covered with the foliage of the plants; the others will be covered more and more as the tillage has been deeper, and the last will completely cover the whole intervals. The roots or bulbs will be in exact proportion to the richness of the foliage, and the weight of the deeply tilled rows will far exceed that of any of the others, while the first will, by comparison, appear a poor and scanty crop, however clear of weeds the surface may have been kept. The soil best suited for this experiment is a good light loam on a dry or well-drained subsoil; for stagnant moisture under any soil will chill the fibres and check the growth of the plants, however dry the surface may be. It was this which led Tull, the father of drill husbandry, to the conclusion that tillage was all that the soil required to maintain perpetual fertility. He carried his conclusion too far; but we shall not be wide of the truth if we assert that with proper tillage the soil will be gradually improved, and a much smaller quantity of manure occasionally added to recruit the waste produced by vegetation will render the soil much more fertile than it would be with more manure and less tillage: and as tillage can be increased by mechanical contrivances where labourers are scarce, whereas the supply of manure must generally be limited, it follows that, as a general rule, the land should be well and deeply tilled, due attention being paid to the nature of the soil and its property of retaining or transmitting moisture. Very loose sands should not be much stirred until they are consolidated by the admixture of marl, clay, chalk, or well-rotten dung; but in all cases the manure should be mixed as intimately as possible with the soil, and as deep as the tillage has gone, not including the stirring of the subsoil; for the roots will always penetrate thus far, and find the nourishment which they require. Those plants which throw out roots from the bottom of the stem, as wheat, barley, and oats, require the surface to be most pulverised and enriched to allow these roots to spread; a spring tillage is therefore highly advantageous, which can only be given when the seed has been deposited in rows by drilling or in patches by dibbling. This last method is found to give much finer crops, from the circumstance that the hoe not only loosens the earth between the rows, but also between the different patches of the growing corn, by which the coronal roots are strengthened and the tillering of the stems so much encouraged, that it is not uncommon to see twenty, thirty, or more strong stems all bearing fine ears arising from one tuft of plants, the produce of one or more seeds, whose roots are matted together and send out fibres in every direction. The crowding of several plants does not prevent their growth, provided the fibres can spread around in a rich mellow soil, well pulverised, and admitting the air and moisture readily.

As a perfect tillage requires much labour and minute attention, and in many situations where the farms are large labourers cannot be procured at moderate wages, nor can they always be depended upon to perform the work with sufficient care, mechanical ingenuity has been taxed to invent implements of tillage by which it may be more perfectly accomplished, and at a smaller expense, by using the power of horses instead of that of men, and making implements which will till a considerable breadth at once, and thus save time.

The old plough, and which, however it may be improved, still acts on the same principle of turning up a fresh portion of the soil, burying that which has for some time been at the surface, will probably always continue to be the chief implement of tillage; but the minuter operations, which are taken from garden culture, require particular contrivances to effect them by instruments. The harrows are but an imperfect substitute for the garden rake, and do not stir the soil to a sufficient depth. Other implements have therefore been invented, which by means of wheels can be regulated so as to act at a greater or less depth. These have received the different names of scarifiers, grubbers, cats'-claws, or cultivators, according to the fancy of the inventors. Many of these answer the purpose well, and save labour. They can be used in all directions so as to pulverise the soil to any degree. Heavy rollers with and without spikes around them are used when many clods require breaking; and, although not yet adopted in this country, the Belgian *traineau,* a strong frame of wood boarded over, and loaded with weights if required, is a most effectual instrument in levelling the surface and crushing clods, without pressing them into the soil, as the roller frequently does.

It would be endless to enumerate all the implements of tillage which are daily invented; some of the most useful have been already described. [Arable Land; Plough.] As the cultivation of the soil approaches more to that of the garden, more perfect instruments will be used; such as can be directed with great accuracy between parallel rows of growing plants without danger of injuring them. When the width of the stetches or beds accurately corresponds with the width of the instrument, so that the wheels will run in the intervals and the horses step in the same, the soil may be tilled perfectly, although the rows of plants have but a small interval between them: and the largest field will thus present to the eye extended seed-beds or equal rows of growing plants, as we are accustomed to see in a kitchen-garden. The result will be the same as when for the sake of experiment we sow the common grains and leguminous plants of the fields in a plot of garden-ground: in such case the produce is so far greater, that it quite baffles our calculation when extended to a large surface, and hence the incredible results which we continually meet with in the reports of experiments on some new produce lately introduced: everything is on a magnified scale, owing to superior tillage. No doubt many fields possessed of fertile soils might, by attentive tillage, be made as productive as the best garden-ground. The Chinese have, as we are told, already accomplished this by their incredible numbers and indefatigable labour; but science and mechanical contrivance are a substitute for millions of labourers when judiciously applied—as our manufactures fully prove. The same ingenuity applied to tillage might increase the produce of the earth, if not indefinitely, at least far beyond what we may now suspect.

In the early ages of agriculture tillage was almost confined to the ploughing of fallows to clean the land, which was very imperfectly executed, and in ploughing the stubble of one crop to prepare for the seed of another, as long as the land would give a return for the labour. The idea of tillage for the sake of a permanent improvement of the soil was only enter-tained by a few men who reflected, and that of encouraging the vegetation while the crop was growing was not even thought of. The plough to stir, and the harrows to cover the seed, were the only instruments in use, and they were very rude of their kind. A return of three or four times the seed sown satisfied the farmer and the landlord; and yet the first was hardly repaid for his toil, and the landlord received for rent what now would scarcely satisfy the tithe-owner. The present state of agriculture may be contrasted with this, and perhaps hereafter the comparison may be as disadvantageous to us as it now appears in our favour when we look back a few centuries.

TIMOTHY-GRASS, so called from a person of that name who successfully cultivated it in North America, where it seems to grow more luxuriantly than any other kind of grass. Its botanical name is *Phleum pratense*, and its common English name is *Meadow Cat's-tail Grass*. It has been highly extolled by many agriculturists for the profusion of hay which it makes, and also for its rapid growth when depastured. It is but a coarse grass when allowed to stand till it is fit for hay; and in rainy weather it so readily imbibes moisture, that the harvest is very precarious. This is a principal reason why its cultivation has not been much extended in England. It is said to give a very sweet and early herbage for sheep in spring, and, mixed with other grasses, may be very useful in laying down land to pasture for a few years.

The soil which suits timothy-grass best is a good moist and rather stiff loam. On gravel or chalk it soon dies off. It is scarcely to be recommended without a mixture of other grasses, although very heavy crops of it have been grown; and from its strong stem, when full grown, it should always be fed off when young, or cut for soiling horses and cattle before the stem has acquired its full growth. That it is not a grass naturally suited to the climate of Great Britain appears from its not being generally found in the best natural pastures. In rich land which is tired of clover it may form a very good substitute, to cut up green and depasture afterwards. The experiments which have been made with timothy-grass are not sufficiently satisfactory to form a decided opinion of its real merits, and it well deserves the attention of experimental agriculturists.

TOBACCO.—The cultivation of tobacco is most extensively carried on in the United States of North America. It requires considerable heat to come to perfection; but with care and attention, and by treating it as an exotic, it may be very successfully cultivated in much colder climates. The least frost injures it; but this is the case with many plants, which are nevertheless successfully cultivated in the northern part of Europe. The seeds of the tobacco plant must be sown in a prepared seed-bed, and be carefully protected from the least frost; for which purpose straw and fern are used, as is done by the market-gardeners who raise early culinary vegetables. When once the danger of spring frosts is over, they may be safely transplanted; and if the ground has been duly prepared, they will arrive at maturity before the frosts of autumn, as is the case with potatoes, buckwheat, and many other plants which are natives of warmer climates. To accelerate the growth of the tobacco plant the ground should have been deeply trenched, and highly impregnated with manure for some time before; for fresh dung, especially that of horses, would impart a rank disagreeable flavour to the leaf. It is therefore by a preparatory course of high cultivation, and by bringing the soil to the state of a rich garden mould, that tobacco may be cultivated without much fear of failure. There can be no doubt that, if it were not for the fiscal restrictions arising from duties imposed upon tobacco by almost every government, the cultivation of it would be a great resource to native industry, especially on a small scale, by cottagers and gardeners. In Holland, of which the climate differs little from that of Great Britain, tobacco is cultivated to a very great extent, even in very poor soils, by great attention to manuring, and by accelerating the growth of the plant.

The seed is sown in a well-prepared seed-bed in March, and protected by mats laid over hoops as long as the nights are cold and frost is dreaded. The ground in which the tobacco is to be transplanted is laid in narrow beds with intervals between them, which are dug out deep, as is done with asparagus-beds, and richly manured with sheep's dung. These beds are two feet wide at top, and two feet six inches at bottom, with sloping sides to keep the earth up: the intervals are only six or eight inches, and serve not only as drains to keep the beds dry, but as paths from which the surface of the beds may be stirred and weeded. Two rows of plants about eight inches high are planted at equal distances along the beds; the rows are sixteen or eighteen inches apart, and the plants at the same distance from each other. In warmer climates the plants are placed three feet apart, as there they grow to a much greater size, and cover more ground: a moist day is chosen for transplanting. The plants are taken up carefully with a small spade or trowel without shaking the earth much from the roots; they are placed slanting in a shallow basket, and thus carried to the prepared beds; they should be vigorous, and have a stem six or eight inches long. They are inserted into holes made by a proper instrument, so that the fibres of the roots and the adhering earth may be completely buried up to the bottom of the stem: four or six leaves should be on the plant; if more, the lowest may be pinched off. If the ground was sufficiently moist, and no great heat or strong sunshine wither the plants, they will scarcely appear to have suffered from the removal; those which die, as must often be the case, are replaced by others left in the seed-bed for that purpose. Great attention must be paid to the beds all the time the tobacco is growing; weeds must be carefully eradicated, and the earth repeatedly stirred between the plants with hoes and narrow spades to accelerate the growth. When the leaves acquire a certain size the lower leaves should be pinched off, to increase the bulk of the upper: for the former are apt to wither before the latter have acquired their full growth. A fine tobacco plant should have from eight to twelve large succulent leaves, and a stem from three to six feet high; the top should then be pinched off to prevent its running and drawing the sap from the leaves. Every lateral shoot should be carefully pinched off as soon as it appears, to prevent branching. A few plants are left for seed, and of these the heads are allowed to shoot the full length. The seeds are so small and so numerous on a plant, that a few plants produce a sufficiency of seed for the next crop. The plantations of tobacco are continually examined, and every leaf injured by insects or otherwise is pulled off. Tobacco takes about four months from the time of planting to come to perfection; that is, from May to September, when the leaves are gathered before there is any danger from frost: one single white frost would spoil the whole crop and cause it to rot. As soon as the colour of the leaves becomes of a paler green inclined to yellow, they are fit to be gathered; they then begin to droop, and emit a stronger odour, and they feel rough and somewhat brittle to the touch. When the dew is evaporated and the sun shines, the leaves may be most advantageously gathered, which is done by cutting down the plant close to the ground, or even a little under the surface. They are left on the ground to dry till the evening, taking care to turn them often, that they may dry equally and more rapidly. They are housed before the evening dew falls, which would injure them, and laid up under cover in heaps to sweat during the night; and some mats are thrown over the heaps to keep in the heat. If they are very full of juice, they are sometimes carried out again the next day to dry in the sun; but most commonly they are left to sweat for three or four days, and then moved and hung up to dry in sheds or buildings made for the purpose, like those in which paper is dried in the paper-mills, which allow a thorough draught of air, but keep out the rain. Every tobacco plantation has such buildings, proportioned to the extent of the cultivation. The floors are most commonly only the soil on which they stand; but it is much better if they are boarded, because on the earth the plants are apt to be soiled, which injures the quality of the tobacco. In some places the leaves are now stripped off the stems and strung on packthread to hang them up to dry; in others the whole plant is hung on pegs placed in rows at regular distances, and fixed on laths which run across the building. All that is required is to place as many plants as possible without their being so near as to prevent the circulation of the air between them. When the plants are quite dry, they are removed in moist or foggy weather: for if the air is very dry, the leaves would fall to dust. They are laid in heaps on hurdles and covered over, that they may sweat again, which they do but slowly. The heaps are carefully examined from time to time to see that they do not heat too much; and, according to the season and the nature of the plants, whether more or less filled with sap, they remain so a week or a fortnight. This part of the process requires much attention and experience; for whether they do not heat to the proper degree or too much, in either case the quality is impaired. An experienced tobacco-grower will ascertain the proper degree of heat better with his hand than the ablest chemist could do with his thermometer. If the leaves were not stripped off at first, which is not the most common practice, they are taken off now, when the proper fermentation is completed, and sorted; those which grow on the top of the stem, in the middle, and at the bottom, are laid separately, as being of different qualities. They are tied together in bundles of ten or twelve leaves, and again dried carefully, when they are ranged in casks horizontally, and pressed in, by means of a round board, by lever or screw, as soon as a certain quantity has been laid in; the pressure is equal to that of a weight of several tons. This is essential to the safe transportation of the tobacco, and it is thus that the great bulk of it arrives from the places where its cultivation is most extensive, as in America.

The finest tobacco, however, is made into rolls, which from their shape are called *carrots*. The leaves are placed together by large handfuls, and wound very tightly round by strips of fibrous wood or strong grass, at a time when the air is somewhat moist; they partially consolidate, and require only to be rasped to make the finest and most genuine snuff, or rappée, as it is called. The snuffs commonly sold, however, are manufactured and prepared in a much more complicated manner.

The refuse stems of the tobacco are sometimes burned; but it is best to let them rot in the ground, where they are converted into good manure for the next crop. From the high state of cultivation of the land, it is left very rich for any other crop after the tobacco; but as this is quite a garden cultivation, the tobacco recurs very soon on the same ground: the abundant manuring and deep trenching prevent any bad effects from this frequent recurrence.

TRIFOLIUM (the *Trifolium incarnatum* of botanists) is an annual of rapid growth, so that in southern climates it may be sown in summer after an early crop of corn, and fed off or cut before winter. It will stand the winter well if sown later, and give very early feed in spring. It produces a great abundance of seed if allowed to ripen; and on its introduction into England great profits were made by the first cultivators of it, by growing it entirely for seed. The price, however, soon was so greatly reduced by abundant production, that it did not repay the exhaustion of the soil consequent on the ripening of the seed. It is, however, a valuable addition to the plants usually raised for fodder, and fills up an interval between other plants by its very early and rapid vegetation. The mode of sowing the Trifolium incarnatum is simple and attended with very little expense. In the month of August, as soon as the crops of corn have been reaped, the stubble is well harrowed to raise a small portion of mould; the Trifolium is then sown at the rate of four bushels of the seed, in the husk, per acre. There is a double advantage in sowing it in this manner: it saves the thrashing required to separate the seed, as a very slight beating will separate the florets of the head or spike sufficiently to sow them; and it vegetates sooner from the moisture retained in the husk which envelops the seed: a bush-harrow is drawn over the land to cover the seed, and it is rolled with a barley-roller, if the land be of a firm nature, or with a heavier roller if it be a loose soil. Thus the Trifolium will vegetate much more certainly than if the land had been regularly ploughed and harrowed, which would have loosened it too much.

It is not advantageous to let the Trifolium incarnatum be cut for hay. Its stem then has acquired a hard woody texture, and it makes very inferior hay. Its principal value is to feed off with ewes and lambs before other feed is ready in spring, or to cut it green for horses and cattle. The ground may be ploughed and prepared for spring crops as early as is required; and thus the Trifolium in no way interferes with the usual rotations. When the common broad clover has failed from any cause, and bare patches are left in the fields in autumn, the Trifolium incarnatum may be sown there with advantage; it will overtake the clover sown in the preceding spring and fill up the deficiency. In this case a mixture of Trifolium incarnatum and Italian rye-grass (*Lolium perenne Italicum*) has been found very useful. If the Trifolium be sown early in spring, it will produce very good feed in a few months, and the land may afterwards be sown with turnips without any loss of time. It must be recollected that the Trifolium incarnatum is a *catch crop*, that is, one which comes in between two regular crops, without interfering with the rotation, and that it costs little more than the seed, which is easily raised, or may be bought at a very moderate rate. All cattle are fond of it in its young state, and it comes in a fortnight earlier than lucern, which is one of the first of the artificial grasses fit for cutting in spring. The great expectations raised at its first introduction not having been fully realized, this plant has rather fallen in the estimation of farmers; but if it is not so valuable as the broad clover in a regular rotation, it ought not to be despised as a subsidiary crop. When the season has prevented the sowing of spring corn, it may be advantageous to sow the Trifolium incarnatum together with Italian rye-grass, as soon as the land is clear of root-weeds. They may be fed off with sheep early in autumn, and the land, being manured or not, as may be thought necessary, may be ploughed and sown with wheat. Thus the Trifolium and rye-grass will come in the place of a clean fallow; and the ground having been covered during the heat of the summer and manured by the sheep folded on it, will be much improved for the wheat crop. It must be remembered that the Trifolium requires a solid bottom, and that the heavy roller should not be spared before it is sown. This is chiefly to be recommended on soils which do not suit spring tares, and as a substitute for these; for under favourable circumstances the tares will produce the greatest quantity of feed. It is, however, useful to have a choice of different green crops, from which may be selected those which offer the greatest prospect of success, when the season, the soil, and other circumstances are taken into consideration.

TURF, the sod which covers the surface of pastures, and is composed of a portion of the soil with the roots of natural grasses or other plants; which gives the whole a consistence, and allows of its being raised in slices by the plough or the paring tool made for the purpose.

The word is often also applied to the substance which is generally called *peat;* and when the latter is taken from the surface where living plants are growing, the name of turf is very applicable to it. It is derived from the Dutch word *torf,* which is generally applied to perfect peat as well as to turf. The origin and composition of peat have been described in its proper place. [PEAT.] We shall only here notice the uses to which turf is applied, when we mean a sod taken from the surface on which some living plants are still growing, or have lately done so. Near extensive heaths which have never been reclaimed, and in situations where no regular peat-bogs are to be found, turf becomes a very useful fuel. It is pared off the surface with the heath growing on it, in dry weather, in sods of a convenient size, generally round and about one foot in diameter. The thickness of the sod depends on the depth and abundance of the roots found in it, as they are the sole cause of the turf continuing to burn when the blaze caused by the burning of the heath is over. As the soil of the places where turf is usually cut is generally of a sandy nature, turf ashes are not so valuable for manuring the land as peat ashes: still they contain portions of potash and other vegetable salts, and produce a very good effect when spread as a top-dressing on moist meadows the soil of which is chiefly composed of clay. In sufficient quantities they are excellent to raise turnips; and it is generally observed, that where poor heathy pastures are pared for the purpose of burning the turf on the spot and spreading the ashes, the turnips sown there seldom fail. For the advantages and disadvantages of this operation, see Paring and Burning.

Where the poor can readily obtain turf for the trouble of cutting it and drying it for use, a degree of comfort is diffused through their cottages which cannot be found where fuel is scarce. In the large open chimney the whole family can be seated by a pile of turf burning on the hearth.

Turf is used for many other purposes, as well as for fuel: laid like tiles on a roof overlapping each other, they form an excellent and cheap protection against rain; cut somewhat thicker, and in the shape of bricks, they serve to build the walls of cabins, which are warm and durable, provided the eaves of the roof project sufficiently to cover them. The soldier who has served through many campaigns knows from experience that a conical hut of turf can be raised in a very short time, if the material is at hand.

When clay is burnt to improve the texture of the soil, the operation is best performed in a circular hearth made of turf, with certain flues to regulate the supply of air to the burning mass. The turf is a slow conductor of heat, and by its means the mass is kept burning steadily in the interior of the heap, without being cooled by the effect of the external air. When the turf-wall itself begins to burn through, it is generally the proper time to mix the whole and extinguish the fire.

The turf which we have been considering is taken from the surface of uncultivated land, and in the course of a certain number of years the wild heaths and other plants natural to the soil spring up again, and by their stems and roots produce a fresh turf; to assist this renovation it is usual to cut the flat turves of a circular shape with a thin paring-tool as we observed before, so that there remain portions of the surface which are not disturbed, and from which the heath and wild plants soon spread over the surface which has been cut. In this way the same spot may be made to give a fresh supply of turves every seven years. This is only done where the soil is absolutely barren, and where its cultivation is not thought of: for at last every remnant of good earth is carried off, the grasses disappear entirely, and nothing but the common heaths can find food for their vegetation.

The surface of good pastures, especially of commons, is often pared for the purpose of forming an artificial turf for ornament or for the purposes of pasture. In the first case those spots are chosen where the grass is of the finest and closest pile. The surface is pared as thin as can conveniently be done, so that the sward shall not break. A proper spot having been chosen, it is divided by the spade, or some sharp instrument like a knife stuck across a long handle, into strips about a foot wide; and a very sharp flat instrument with a bent handle, so as to work horizontally, is thrust an inch, or a little more, below the surface, paring off the strip which has been marked. As the workman who cuts the sod advances, another rolls it up before him, until it is of a proper size to be carried off. A cut is then made across the strip, and another roll is begun. Thus a large space may be completely bared, or parallel strips may be cut out, leaving some of the turf uncut between them. In this case the loss of the herbage will be soonest repaired by the spreading of the grasses from the strips which are left. When an ornamental lawn is to be formed by laying down the turf, the ground is levelled, or laid in any desired form. It is well rolled and beaten, to make it firm, and if the weather is dry, it is well watered before the turf is applied. As lawns require frequent mowing, a close, slow-growing turf is a great advantage: it should therefore be taken, if possible, from a poor thin soil. The turf which lies immediately over the chalk is best adapted to this purpose. If the ground to be covered is of a rich quality, it is best to remove the soil and lay some of the poorer subsoil bare, to place the turf on: a rich moist soil would make the grass grow too rank, and require constant mowing and rolling to keep it down. Brickbats and rubbish are often spread over the ground, where a lawn is to be formed by turfing it over: these not only form a poorer soil, but also keep it drier by their porosity. It need not be observed, that where turfing is resorted to, to cover bare places in meadows or pasture, the reverse of all this should be done, and manure spread over the places where the turf is to be laid, so that the roots may be invigorated and a rich pile of grass may spring up.

When there are banks and inequalities in pastures, it is often useful to pare off all the turf, rolling it up, from the places which are to be levelled. The superfluous soil is then removed, and if it has been long in the form of a dry bank, it is spread over the grass, which it greatly invigorates. The new surface is enriched with manure, if it requires it, and in moist weather, or after watering it, the turf is unrolled over it and well beaten down. A heavy roller drawn over it will greatly assist its rooting, and thus an unsightly bank, on which the grass was usually either coarse or burnt up, according as the season was wet or dry, becomes a good and neat pasture. Another important use of turf is to cut it into small strips and divide these into pieces of a square inch in size, or somewhat more, for the purpose of laying land to grass by *inoculation.* This is only a partial turfing, which extends rapidly, and in the course of a very few years converts a field which was not very productive as arable land into a valuable meadow, especially if it is so situated as to be capable of occasional irrigation.

The advantage of an extent of fine turf for the exercise of high-bred horses has given a name to the pursuit of breeding and training horses for the purpose of racing. The annals of the turf record the deeds of famous horses and the success of their owners. The turf has its rules and codes of laws, and the highest individuals in the nation often sit in judgment on some disputed point of law, with as much gravity as they would decide the most important interests of the state.

TURNIPS. *Brassica rapa.* This well-known plant is cultivated for its bulbous roots both in the garden and the field. As a culinary root it has been prized from the earliest times, and many varieties have been cultivated for the table; but it is those of a larger kind, cultivated in the fields, which form so important a part of the most improved systems of agriculture on all light soils, that the success of the farmer is, in general, proportioned to the quantity of turnips raised on his farm. They are the great foundation of all the best systems of cropping, by supplying the manure required for the subsequent crop, and, at the same time, clearing the land of all noxious weeds, by the numerous ploughings, stirrings, and hoeings which they require.

Turnips were first raised upon land which had already borne a crop that was reaped early in summer, and on fallows which had been worked and cleared early, so as to leave a sufficient interval between the last ploughing and the time of sowing winter corn to have a tolerable crop of turnips. These turnips, however, which are still cultivated by the name of stubble or eddish turnips, never grow so large as those which had been sown earlier on land well prepared and highly manured.

The regular cultivation of turnips on a large scale was originally introduced from Flanders into Norfolk two centuries ago, and from Norfolk was brought into the south of Scotland and the north of England about a century after. It was long confined to one or two individuals, who cultivated turnips very successfully; but at last it spread, and was greatly improved by introducing the row culture, according to Tull's system, which acquired the name of the Northumberland mode of cultivation. The usual mode of sowing turnips both in Flanders and in Norfolk was broadcast, and, as the labourers in both countries became very expert in hoeing them out at regular distances, this mode was long preferred. In fact, the cultivation of turnips in rows is scarcely practised at all in Flanders, and, notwithstanding its evident superiority in respect to quantity of produce and economy of labour, it cannot be said to be yet universally adopted in Norfolk and the neighbouring counties — so slowly does every agricultural improvement spread among the great mass of farmers. All farmers, however, who have any pretensions to a good system of cultivation adopt the Northumberland plan, of which a short account will be found in the agriculture of that county in this work. But there are some particulars not mentioned there which are worthy of notice, and which lead to still further improvements in the practice. The great object on poor light lands, especially those which have lately been brought into cultivation, is to raise a crop of turnips; for when once this is obtained, and the land has been improved by the folding of sheep upon it, there is no great difficulty in maintaining the fertility thus produced by judicious management and frequent green crops. Great improvement in poor soils has been effected by the introduction of ground bones as a manure, which have the peculiar property of favouring the growth of the turnip, and have consequently been used on poor light sands and gravels to a great extent, and with unvaried success, without much help from farm-yard manure. It has, however, been found that a much greater profit is obtained from the land by uniting the regular application of farm-yard dung with that of the bone-dust. For this purpose the best farmers prepare their land, where they intend to sow turnips, early after harvest, by giving it as complete a cultivation as they can before winter; and they put on it a good coat of manure, and plough it in. In the beginning of summer another ploughing is given, with repeated harrowings, to destroy the weeds which have sprung up. If the subsoil is dry, or the land has been thoroughly drained, the seed may be drilled in rows from two feet to thirty inches apart, with bones or any equivalent artificial manure on the flat surface. The turnip-seed can scarcely fail to vegetate soon: less danger arises from dry weather than if they were on the top of a ridge, and the intervals can be readily stirred by the plough, or any other instrument adapted to the purpose. The manure, which has had time to incorporate with the soil and to impart to it the various gaseous products of its decomposition, is in the best state to nourish the young plant, until it can push forth its roots, and feed, as it were, on the bone-dust; a more rapid growth is ensured, which is the best preservative against the fly; and experience has proved that this is a much more certain way to ensure a good crop of turnips, especially of swedes, than the old method of putting all the manure immediately under the seed in the rows, where it often remains inert if dry weather comes on soon after the seed is sown. The quantity of manure put on in autumn, or very early in spring, depends on the means of the farm: if ten cubic yards of short dung can be afforded per acre, the crop of turnips will amply repay it; and twenty bushels of bone-dust or less per acre will be sufficient to drill with the seed. Long fresh manure may be safely ploughed in before winter, which would be very improper in a light soil if used in summer. This will be rotten before the turnips are sown, and all the expense of forming dunghills and turning them over is saved. There is no danger of the manure being wasted; for whatever weeds may be produced will be ploughed in and returned to the soil. All the nutritious parts of the decomposing dung will be absorbed by the earth, and none of them will evaporate. Where farm-yard manure is scarce, half the above quantity may be used, and a fair crop of turnips may still be expected. We have ourselves followed this method with abundant manure, and also with half the usual quantity, the success being always in proportion to the quantity of farm-yard manure.

The early vegetation of the seed is

essential to a good crop of turnips. In its young and tender state it is liable to a variety of accidents. Its great enemy is the turnip-fly (*altica nemorum*), which appears always in great quantities if there is any continuance of dry weather. The more frequently turnips are sown on the same ground, the more abundant is the fly; but where the surface has been pared and burned there is seldom any loss from this cause. Many remedies have been proposed for this evil, and some with great confidence. It appears that the fly remains in the state of an egg in the ground, and that it is hatched when exposed to the light and heat of the sun. The time at which it begins to attack the seed-leaves of the turnip coincides with their vegetation; and it has therefore been proposed, with some appearance of reason, to let the insect have the start of the turnips, by leaving the land some time undisturbed before the seed is sown, and carefully cleaning it, so that the insect shall find no food, and consequently die. This is supposed to require ten or twelve days to effect. The seed is then drilled and the land rolled; and it is asserted that the ravages of the fly are thus entirely prevented. However this may be, it is generally found that in moist weather the fly does comparatively little harm, as then the vegetation is rapid, and the plant, when once it has put forth its rough leaves, is considered safe. Whatever, therefore, accelerates the vegetation, will secure the growth of the turnip. Hence the advantage of dunging the soil before winter, by which means it is enriched uniformly, and a great portion of the manure, having become soluble, absorbs moisture from the atmosphere. In very dry seasons, if water is at hand, it is well worth while to water the newly-sown rows by means of a common water-cart; and if some liquid manure be mixed with the water, the effect will be astonishing. By means of two leathern hose two rows may readily be watered at once; and if the pond or stream be not above half a mile off, a vast extent of ground may thus be watered in one day. Nothing brings on vegetation so fast as diluted liquid manure, care being taken that it be not too strong. The best time for watering is in the evening, or early in the morning; and if in a fine summer's night the water-cart were used before day-light, there would be no great inconvenience to the horse or his driver. It sometimes happens in soils rather compact, that a crust is formed on the surface which has been harrowed fine and rolled, and this impedes the vegetation by excluding the air necessary to germination. In this case no better remedy can be applied than watering, which softens the crust and lets the young plant through. As soon as the turnip-plant has put forth its rough leaves, the intervals between the rows should be stirred with a light plough drawn up by one horse. The plough can be made to go within an inch or two of the plants, throwing the earth from the row into the interval: a small harrow, which can be set to any required width, is then drawn between the rows, to loosen the earth raised by the plough. This greatly increases the absorption of moisture and invigorates the young plants. They may now be thinned out in the rows by means of a hoe about twelve inches broad, which will hoe out all the superfluous plants, leaving little tufts a foot or more apart. These tufts are thinned out by hand, leaving only one healthy plant in each. Thus the turnips are left at a proper distance, and, having ample room, will soon cover the rows. A horse-hoe is now drawn between the rows, to eradicate all weeds and keep the soil open for the fibres of the roots to shoot in. It is not advisable to throw the earth over the turnips, unless it be just before winter, to protect them from the frost; on the contrary, in wet weather the earth is more likely to cause the turnip to rot than to help its growth. The fibres which draw the nourishment strike in the soil below, and spread between the rows wherever they meet with a loose and mellow earth.

In order to have a heavy crop, especially of Swedish turnips, or *ruta baga*, it is advisable to sow the seed early, that is, in the beginning or middle of May. They will then have the advantage of the summer showers, and be beyond the reach of the fly in a very few days; and when the dry weather sets in, they will already have a supply of moisture in their roots, and the fibres, having struck deep, will not suffer any check. The only inconvenience of sowing early is, that many of the plants are apt to run to seed. This is in many cases owing to the seed which is used. If the seed has been raised from fine roots which have stood the winter, there is little danger of the plants running to seed in the first summer; but, as is often the case, if small imperfect roots are taken, or those which run to seed in autumn, then the plants will have a tendency to produce seed and not bulbs. The white Norfolk turnip and its varieties should be sown about midsummer, to have a good and heavy crop before winter. The distance at which they may be left in thinning them out must depend on the variety, whether it has a wide-spreading top or not. The best crops, both of swedes and common field turnips, are generally those where the tops are vigorous and moderately spreading. A small top will not nourish a large bulb; but when the growth is chiefly in the leaves, the bulbs are seldom large.

It may be considered as a general rule, that the most advantageous mode of consuming turnips is to draw them and cut them in slices in the field, to be there consumed in troughs by sheep, to whom corn or oil-cake, as well as hay, is regularly given. When the crop of turnips is abundant, part of them may be stored for the cattle in the yard or fatting-stalls, and for the milch-cows and heifers. They will require nothing but good straw, if they have plenty of turnips, and no hay whatever need be used, unless it be for the horses; and even they will thrive well on Swedish turnips and straw, with a small quantity of oats. Turnips are often left in the field all the winter, which greatly deteriorates them. If they cannot all be fed off before Christmas, they should be taken up, with the tops on, and set close together, covered with the tops, on a piece of grass, or in some dry spot. They will thus be quite sufficiently protected from the frost: or the tops may be cut off within an inch of the crown of the root, and they may be stored in long clamps five feet wide and four feet high, sloped like the roof of a house, and covered with straw and earth, in which state they will keep till they are wanted. It is advantageous to have different varieties of turnips, which will come to perfection in succession; and it is useful to sow some at different times for this purpose. The small turnip, which from its rapid growth is called the nimble turnip, may be sown as late as the end of August, and in mild seasons will produce tolerable bulbs in winter and early in spring. The frost will not injure a growing turnip so readily as one which is come to perfection and the leaves of which are withered. Some varieties, like the yellow Aberdeen and the green round turnip, are hardier than others, and will stand the winter well in a light and dry soil.

There are so many varieties cultivated, that it is difficult to enumerate them. The Swedish turnips may be classed according to the colour and size of their tops and the shape of the bulb. The best have but little stem rising from the bulb, and a good tuft of leaves. The substance of the turnips is of a bright yellow and has a strong smell, especially when they have been kept some time. No frost will hurt them, if they are kept dry; but alternate rain and frost will do them harm. When they are stored, it is advantageous that the air should have free access; and for this purpose it has been recommended to place them between hurdles set upright, and to slightly thatch them with straw to keep out the rain. In this way they keep longer sound than when put in clamps covered with straw and earth.

Of the field turnip there are numerous varieties. The common Norfolk turnip is round and flat, the bulb being half buried in the ground; it throws out no fibres, except from the slender root which proceeds from the centre of the bulb. There is a subvariety which is reddish at the insertion of the leaves, and another of a green hue: the latter is the hardiest. The globe turnip takes its name from its shape; it rises more out of the ground, and grows to a greater size; like the last, it is either entirely white or red or green near the crown. It is on the whole the most productive and hardy. The tankard turnip rises high out of the ground, and approaches in shape to the mangel-wurzel. It grows to the greatest size: but it is apt to become spongy if left long on the ground, and its weight is not in proportion to its bulk. There are red tankards and green tankards, as well as white. The green round turnip is considered very hardy, and is usually sown late, to be consumed after the winter. The yellow Aberdeen, although somewhat less, is compact, and stands the winter well: it is a very useful variety.

Next to those above mentioned come the smaller turnips of quicker growth, which have mostly been taken from the garden.—They should not be sown early, as they are very apt to run to seed in dry weather; but in a moist climate they may be sown at any time in the summer, and they will be in perfection in three months. Thus they may be made to fill up the interval between the early rye or Trifolium, fed off in spring, and the wheat sown in autumn.

Those who are possessed of a good variety will do well to raise their own seed, as that which is bought cannot always be depended upon for this purpose; the best-shaped middle-sized bulbs should be chosen, the leaves being cut off not nearer than an inch from the crown. They should be planted in a mellow soil, in rows three feet wide, and a foot from bulb to bulb in the rows, about March or April. When the pods are well filled with seeds, and these are round and hard, the stem should be cut close to the root and carefully laid under a shed to dry. The seed will ripen there without shedding, and when the pods are quite dry, the seed is easily beaten out with a stick or light flail. Birds are so fond of it, that a constant watch must be kept, and this is the reason why so few farmers grow their own seed. Turnip-seed is often raised in the gardens of cottagers, whose children keep off the birds, and it is a branch of industry which every farmer should encourage. He can readily see that good bulbs only are used, and he secures the seeds he wants, while the cottager is well paid for his trouble. This is perhaps the most convenient mode of raising the seed on a large farm. If the seed is kept in a dry granary, it will be good for several years. It is however best to use fresh seed, as it always germinates sooner. The seed is seldom steeped, but generally drilled in the rows by a drill-barrow or more perfect sowing-machine. The best farmers, even on land well manured and in good heart, sow with the seed some artificial manure, as bones, rape-cake, or rich dried compost, to accelerate the first growth of the plants. Machines which sow the seed and manure in drills at the same time may be had of most of the manufacturers of improved agricultural implements.

UREDO. As the diseases of corn occasioned by fungi belonging to the genus *Uredo* are of great importance, we shall describe them particularly. In the article BURNT-EAR a diseased state of wheat is described, in which the *Uredo segetum* appears.

Uredo Caries, De Candolle. (*U. fœtida*, Bauer), is found on wheat: the sporidia are included within the ovary of the fruit, and are exactly spherical, rather large, globose, and black. When this plant appears on wheat it is said to have the Bunt, Smut-balls, or Pepper-brand. The sporidia may be detected in the young seed in the very earliest states of the flower-bud, and when perfectly ripe it occupies the whole interior of the grain, but does not burst the skin, so that the grain retains the character of being perfectly sound. The sporidia are frequently mixed with delicate fibres, which seem to constitute the mycelia of the plant. Henslow calculates that a single grain of wheat may contain more than 4,000,000 of sporidia. Each of these sporidia probably contains millions of sporules; hence some idea may be formed of their minuteness, as well as their capacity for spreading themselves in every direction. Another peculiarity of this fungus is that it has a very disgusting smell, and the consequence is that flour made from grains containing it cannot be eaten. Flour thus spoiled is however sold to gingerbread-makers, who have found out that mixing it with treacle conceals its disagreeable odour. It does not appear to act injuriously when taken. In raising wheat for seed the greatest care should be taken that none affected with the smut-fungus is used, as it seems proved that where the sporules of the fungus are present in the seed sown they will grow up with the plant, and be developed at the period of its ripening its fruit. Many remedies have been proposed for getting rid of the sporules from wheat about to be sown. Washing with clean water has been found effectual, and with lime-water much more so, but of all applications a solution of sulphate of copper (blue vitriol) seems to answer best. The following is a good instance of the effect of dressing wheat:—'Mr. John Woolnough, of Boyton, sowed a large field in alternate breadths with wheat taken from a good sample without dressing, and wheat that had been dressed. Long before the corn was ripe the difference was most distinguishable. Upon those stretches sown with dressed wheat it was difficult to find any branded ears, whilst the others were so branded as to make him determine to carry the corn at separate times to different places.' (*Linn. Trans.*, vol. v.)

Uredo rubigo and *linearis* form yellow and brown oval spots, and blotches of an orange and yellow colour upon the stem, leaf, and chaff of corn, and various grasses. The sporidia of *U. linearis* are more oblong than those of *U. rubigo*, but they are frequently found together. When these plants are present the disease of the corn is called Rust, Red-rag, Red-robin, and Red-gum. This is the plant which Henslow believes to be identical with the Puccinia graminis, which occurs in corn affected with mildew. The mildew and the rust are often confounded together by farmers, and, as shown by Henslow, there is no difference in the essential character of the plant which is the offspring of the disease. Some beautiful drawings of the Puccinia by Bauer, with an account of the mildew, were published by Sir Joseph Banks in 1805. There are also some admirable delineations of the plants of both smut and bunt by Bauer, in the 'Penny Magazine' for 1833. Rust and mildew are not so certainly prevented as smut, although there is reason to believe that the sporules of the U. rubigo are taken less up by the roots, in the same manner as those producing smut. As a dressing, the use of the lime-water or sulphate of copper should never be neglected; although it may not always prevent rust, yet there are instances recorded in which undressed wheat has had rust, when dressed wheat from the same sample has not had it.

Connected with the question of blight in corn is one that has produced much discussion, and that is, how far the Barberry (*Berberis vulgaris*) is the cause of it. There is a very general impression amongst farmers that the barberry-bush produces rust in corn, and there are numerous well-authenticated instances of blight occurring in the vicinity of barberry bushes and hedges. Botanists, not seeing how this could occur, have generally treated the fact as a coincidence, and acquitted the barberry altogether of the crime of producing blight; but the evidence of blight occurring as the consequence of the presence of the barberry is constantly increasing. One of the best explanations of this curious circumstance is, that the barberry itself is subject to the attacks of a fungus, the Æcidium berberidis, similar to that which produces the disease in wheat. The specific characters of the two however are very different, and it is only by having recourse to the supposition that many of the recorded species of Æcidium are merely varieties changed in character by change of position, that such an explanation of the fact can be admitted.

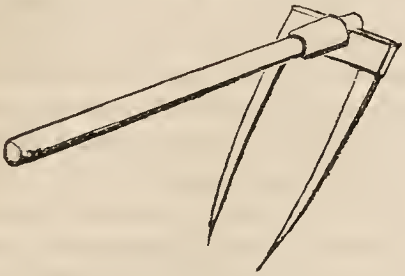
Besides the species of Uredo mentioned, corn and all other plants are subject to the attacks of a large number of these fungi. On whatever plant they are found they are indicative of disease, and the produce of the plant will not be so great as when in a state of health. Sir H. Davy found that a thousand parts of good wheat yield, on an average, 955 parts of nutritious matter, whilst specimens from mildewed wheat yielded only from 650 to 210 parts in the same quantity.

VINEYARD. The vine only thrives in particular climates, where the autumns are not excessively hot, nor the springs subject to late frosts. It has been observed in France, that the line which marks the northern boundary of the vineyards is not parallel to any circle of latitude; but that it lies obliquely, advancing more to the north on the eastern boundary of the country than on the western. It seems to depend more on the nature of the climate in spring and autumn, than in summer and winter. A hard frost at the time the sap is quiescent has no bad effect on the vine, but rather the contrary; while a late frost in spring disappoints all the hopes of the vine-grower. There was a time when the vine was cultivated in England for the purpose of making wine: and whether the climate is altered, or the foreign wines have superseded the sour home-made wines, no one now attempts to cultivate the vine except for the purpose of obtaining grapes for the table, and the mode of cultivation is a branch of horticulture.

It may however be interesting to know how the vine is cultivated in the countries which produce good wine; of which France is one of the principal and nearest in climate to England. The vine grows best in a soil where few other shrubs or plants would thrive, and it seems a wise distribution of Providence, that where there is the best soil for wine, there it is the worst for wheat, and *vice versâ*. The vine delights in a deep loose rocky soil, where its roots can penetrate deep into fissures, so as to insure a supply of moisture when the surface is scorched by the sun's rays. On the steep slopes of hills towards the south and sheltered from the north-east, the grapes attain the greatest maturity, and the vintage is most certain. So great an influence has a favourable exposure, that in the same vineyard the greatest difference exists between the wine made from one part and that made from another, merely because there is a turn round the hill, and the aspect varies a very few degrees. A change of soil produces a similar effect. The famous Rhine wine called Johannisberg, when made from the grapes which grow near the castle, is worth twice as much as that made a few hundred yards farther off. Here both soil and aspect change. The *Clos de Vougeau*, which produces the finest Burgundy, is confined to a few acres; beyond a certain wall the wine is a common Burgundy, good, but without extraordinary merit.

The best vineyards in Europe formerly belonged to monasteries, and the quality was then thought of more importance than the quantity; of late the demands of commerce have made the quantity the principal object, and to this the quality is frequently sacrificed.

When a vine is first established on any spot where none grew before, the first thing is to prepare the ground for planting. In steep places, where the soil might be carried away by rains in winter or spring, terraces are formed by building massive stone walls along the slope, and levelling the soil behind them. The walls serve to reflect the heat, and form a shelter to the vine below. Thus a whole hill is sometimes covered with terraces from top to bottom, and there the wine is generally good, if the exposure is favourable. Limestone, gravel, or coarse sand, with a small mixture of clay, forms a good soil for a vine; vegetable substances alone should be used to enrich it, such as the leaves and tendrils of the vine, the residue of the grape when pressed, and, failing these, the leaves of trees collected when green, and formed into a compost with earth. The ground should be well trenched, if it will admit of it, or loosened with the mattock and pickaxe, as we should do a mass of gravel which was to be spread on a road, and which was too hard for the shovel or spade. The different parts of the soil should be intimately mixed, keeping some fine earth or soil at top to set the plants in. When the ground is prepared, holes are dug in rows four or five feet wide, at the same distance from each other, so as to alternate; some of the finest of the soil is put into each hole, and the vine-plants which have been rooted in a nursery, or else simple cuttings, are carefully inserted, pressing the mould round the roots, and levelling the earth round them. Rooted plants will bear the second or third year, but cuttings take a much longer time. The season for planting is during the winter, when the weather is open. If cuttings are used, they are taken off the vine on which they grew at the usual time of pruning after the vintage; a piece of the preceding year's wood is left on the cutting, and when it is planted the end where the old wood is left is bent or twisted to facilitate its striking: three or four eyes are buried, so that the end is a foot at least underground. If the plant is already rooted, care is taken not to wound or bend the roots, but to spread them out and cover them with mould. During all the time that the vine is growing, the ground must be regularly cultivated and kept perfectly clear of all weeds. The usual instrument of tillage in stony and rocky soils is a two-pronged fork fixed in a short handle at an angle less than a right angle with the prongs, which are a foot long, and very strong, like a double pickaxe (see figure). This is struck into the ground and then drawn towards the workman, while the handle is lifted, which acts as a lever in raising the soil. The roots are by this means enabled to spread through the soil in search of moisture and food. The next year it is usual to prune the young vine down to one or at most two eyes or buds; but some experienced vine-dressers recommend deferring this operation to the second year, by which, although the vine will not be so forward in fruiting, it will be much strengthened, and fully repay the apparent loss of time in the end.



In the third year the vine is trained, that is, the shoots are tied to upright stakes planted at each root, or they are laid in an arch and tied from one root to another along the ground. In southern climates trees are planted at a certain distance from each other, and the vine, planted at their foot, is allowed to run up their branches, from which it is led in festoons from tree to tree, while the head and branches of the tree are cut off to prevent too much shade. This is by far the most elegant mode of training the vine; but in France the stakes and the low training are the only methods suitable to the climate. The pruning is generally done in the beginning of winter.

When vineyards are established in the plains, where sometimes, as those of Medoc, they produce very good wine, the intervals between the plants can be stirred by the plough, although forking and digging by hand is more common; hoeing is as necessary in a vineyard to destroy weeds as it is in a field of turnips or any other crop sown in rows. Wherever a vineyard is overrun with weeds, you may be sure that there is no good wine, and much poverty in the proprietor. The pruning of a vine in bearing, the object of which is to produce much fruit without weakening the plant, can only be learnt by experience and practice; much of the success of a vineyard depends on this operation. In the best vineyards no manure is used except that which we mentioned before, of leaves and tendrils; but some soils require to be recruited, and without manure would produce little or no wine. In this case there is no alternative, and composts must be formed, as is done in common cultivation, with animal and vegetable substances mixed and decomposed. Horse-dung should be avoided, if possible; cow-dung is cooler and more nearly of a vegetable nature; this should be mixed with as much virgin earth from pastures and meadows as can be procured, and laid in small heaps in the intervals between the rows. It may be left a little while if it has any rank smell, and then forked in round the roots; the more it is decomposed the better. Many a vineyard has lost its reputation after having been abundantly manured. The Johannisberg was much reduced in value after having been dunged, while in the possession of General Kellerman, and it has not yet regained all its former reputation.

After a certain time, which differs in different situations, the vine becomes less productive from the exhaustion of the soil, as is the case when the same crops are repeatedly sown in the same ground: this depends on the depth of the soil. All perennial plants shoot out their roots farther and farther every year in search of fresh earth, and it is by this means that trees flourish for a long time on the same spot; but if the roots are prevented from spreading, or, the plants being too crowded, their roots interfere, a diminution of vigour is the consequence. So it is with the vine. In some situations, where the roots strike in crevices of rocks in which rich earth is accumulated, the vines will continue in vigour for many years; but where their progress is arrested by a solid rock or substratum, they will in time show signs of exhaustion. In this case the remedy is the same as for land bearing corn. A fallow, or rest, as it is usually called, is necessary, together with the addition of such manures as shall restore the lost fertility. For this purpose a portion of the oldest roots are dug up every year, and the ground trenched or loosened two feet deep or more with the mattock, to expose it to the influence of the atmosphere. A compost is prepared with sods taken from pastures, or any virgin earth which can be procured; this is mixed with some lime and turned over several times, to rot all the roots and grass which may be in it, and to make it a uniform and rich mould. Holes are now made, exactly as when a new vine is planted, and in each of them a basket or barrowful of earth is thrown; in this the new plants or cuttings are planted to produce new vines in due time: thus the vineyard is gradually renovated. The proportion thus fallowed every year depends on the natural duration of the vine in that particular situation. In inferior soils one-seventh is thus renewed every year; in some a twentieth part is sufficient; and there are vineyards which have never been renewed in the memory of the present generation, but these are few in proportion to the rest.

WARPING, a mode of producing a deposition of the earthy matter which is suspended in rivers of which the current is frequently changed by the rising and falling of the tide. This causes a stirring of the water, which prevents the finer particles from being deposited. It is only necessary to produce a stagnation of the water for a few hours to have a copious deposit, leaving the water clear over it.

On the low flats which border the mouths of rivers occasional inundations often cause a deposit which is highly fertilizing. Thus the polders in Holland and Flanders have been formed of the mud of large rivers, and, being drained and kept dry by dykes and sluices, have formed the most fertile soils.

Warping is an imitation of this natural process:—A bank of earth is raised along the course of the river, so high that the floods cannot pass over it. In some part of this dyke is a sluice for the double purpose of letting in the water and letting it out at pleasure. When the tide is setting in and counteracting the natural current of the river, the sluice is opened, and the water flows in by one or more channels made for the purpose of conveying it over the lower land, and covers it to the depth of high water. The sluice is now shut, and the imprisoned water becoming stagnant deposits all the mud which it held suspended before. The sluice is opened at low water, and the water is allowed to run out slowly; it leaves a coating of mud or sediment, which hardens and dries rapidly. This operation is repeated until a thickness of several inches of new soil has thus been warped, when it is allowed to dry, and then ploughed and cultivated like any other field. It takes some time before any corn will grow on the new warp: at first it looks like barren mud, but it soon dries to a better texture, and ultimately produces very extraordinary crops. If its fertility decrease, and its surface is still below high-water mark, a slight warping, like the inundations of the Nile, immediately restores the fertility. What is curious is the almost total absence of organic matter in the warp-soils, or rather, its intimate combination with the earths, so that it is not readily separated from them. It is neither like clay nor sand, but something between the two, soft to the touch, but not hardening into lumps when dry: neither very porous nor very retentive of moisture. The principal earth is silica in a very fine state. It generally contains a portion of calcareous matter, probably from comminuted shells. It produces beans, oats, potatoes, and wheat in abundance, without any manure. It is admirably adapted to the growth of flax, especially when the warp is of a good depth.

The principal expense in warping is

the sluice, and the canal through which the water is conducted over the land; the longer this latter is, the slower the process, as much warp is deposited in the canal, which has sometimes to be dug out. Accurate levels must be taken, or much expense may be incurred uselessly, if the water will not cover the surface to a sufficient depth.

It is of little consequence what the soil was originally; for a new soil is deposited over it. It should however not be too wet nor marshy: a porous soil is best, as this becomes the subsoil. All the inequalities which existed before are obliterated by the warping, which fills up all cavities, and leaves a perfectly level surface. At an outlay of 2000*l.* a surface of 300 acres has been warped, increasing the value of the land more than 10,000*l.* in the course of four years—a very profitable speculation. The fertility of warped land naturally leads to the conclusion that silica, in a very comminuted state, becomes best adapted for the roots of plants to shoot in and to supply them regularly with the moisture necessary to their vegetation, and that their chief nourishment is derived from the atmosphere, since very little organic matter can be detected in warp, and few mineral substances besides the earths.

WARWICKSHIRE AGRICULTURE. This county, being situated nearly in the centre of England, has a comparatively mild and healthy climate: except in the higher and more exposed situations, where the soil is cold and heavy, the harvest is as early as in more southern counties.

The soil varies extremely, so that two or three different kinds of soil are often found in a field of no great extent. The red loam, which is found to a considerable extent across the centre of the county, and especially between Warwick and Coventry, and from the borders of Worcestershire to Leicestershire, is mostly of a superior quality; all of it very fit for white crops, and much of it capable of bearing both beans and turnips. Where the loam inclines to sand, the subsoil is chiefly limestone, marl, or sandstone; and under the colder and heavier loams the substratum is clay. There is also a fertile clay on limestone. The best soils, as is generally the case, are not cultivated with that care and economy which would greatly increase their value. Where the tenant can get an easy livelihood without much outlay, exertion, or risk, improvements are very slowly adopted. It is from the proprietors chiefly that improvements originate; and unless the tenant has the advantage of a long lease, he has little motive for improving his farm. From various reasons of a political nature, and from old prejudices, there is a general disinclination in landlords to grant long leases, and yet nothing tends so much to improve a property. Some proprietors begin to see this, but many prefer the old system, and like to see their tenants somewhat dependent on their good will. The farms used to be of small extent formerly, but many have been thrown together of late years, and there are now some extensive occupations. A great part of the land was formerly in common fields, but is now mostly inclosed, and, as a natural consequence, better farmed; but many improvements might still be introduced, not only in the course of cropping, but in the economy of labour, especially in ploughing: fewer horses and men might be employed, by a more general adoption of the light two-horse ploughs; some of the heavier loams may require three horses to plough them when the soil is wet and heavy, but it is absurd to use four horses and only make a furrow an inch wider than you could with two, or at most three. Besides, a very wide furrow is seldom of advantage, whatever a deep one may be.

The course of crops on the best loams used to be: a clean fallow—wheat, beans, oats or barley, and clover—and sometimes two white crops succeeded each other after the fallow. A better rotation is—fallow, barley, clover, wheat, beans, oats—manured on the fallow and for the beans; and if these last be well hoed and the land in good heart, another crop of wheat may be taken after the beans, instead of oats. Potatoes grow well in some of the lighter loams, and they, together with turnips and mangel-wurzel, well manured, take the place of the fallow, and are followed by barley, clover, and wheat.

Lime is used in considerable quantities, and with very good effect; it improves the quality of the wheat, and increases the crop.

On the light loams and sands turnips have been long cultivated, but till lately not with the care which they deserve. They were generally sown broadcast, and thinned out by hoeing; and the sheep were folded on them, to eat them as well as they could. This is now done on a much improved system by some of the best farmers. The land is better prepared, the turnips sown in drills over the manure, and the roots are cut by a machine in the field, and given to the sheep in troughs, with clover-hay cut into chaff, and oil-cake or meal: in this way the crop is much heavier, and the sheep thrive better, while the land is more richly manured. There is a great extent of excellent pasture land in Warwickshire, and although some of it is very capable of being converted to arable land and farmed on the convertible system of husbandry, the landlords do not readily give their tenants leave to break up old sward. It is only on poor pastures that breaking them up may be advantageous; and although more food is produced by arable land for the public, the farmer will always prefer that system which is most profitable to himself, and the landlord that which ensures the highest and most regular rent. But pasture land may be badly managed as well as arable, and much of the grass land in Warwickshire is sadly neglected. Docks and thistles are allowed to grow and extend; moles and ants raise hills which diminish the useful surface; the dung of the cattle is allowed first to burn the place where it drops, and then to be carried away by insects.

On the heavy lands in this county, as in most others, the custom of continually ploughing from the crown and gathering the furrows, as it is called, has produced such high ridges that a man might be hid behind them; and the water always running down the steep sides of the ridge, made a kind of morass in the deep intervals. All the best soil was accumulated in the crown, and there only the plants were vigorous. On a better system being introduced, great difficulty arose in levelling these high and always crooked ridges. The most scientific farmers or proprietors took advantage of the low furrow to put in a drain of broken stones or tiles barely covered with earth. By twice gathering four or five furrows on each side of this drain a little ridge was formed, and in course of time the large ridge was split in two. As soon as cross-ploughing could be effected, the whole was soon brought to a tolerable level. The drains now were covered with a sufficient depth of earth; but the old crowns were pared down to the hard subsoil, and it took much lime and manure, with several fallows, to render them equally fertile with the new. In some fields not long levelled, ploughed in straight and regular ridges, the wave of the crown of the old ridge could be distinctly traced in the crop by a deficiency in produce; while the old hollows were the more luxuriant from the accumulation of fresh soil.

Thorough-draining is in its infancy in this county; but where the subsoil is clay it will no doubt soon become universal. The great superiority of the rich loams lying on sandstone arises in part from being under-drained by nature, without which all their natural fertility would have been of little advantage.

There are not many water-meadows in the county, and considering the copious springs which rise from the calcareous rocks, and might easily be collected and carried over the grounds situated below their level, it is surprising that so little use is made of these advantages.

In the neighbourhood of Warwick, Coventry, and especially Birmingham, much land is laid out in gardens, at a high rent, and well cultivated: pieces of meadow land, likewise, for feeding milch cows, are let very high near these manufacturing towns. The mechanics delight in a small spot of ground, in which they work themselves or employ labourers, as a relaxation from their counting-houses and workshops. These gardens are generally highly cultivated.

The county of Warwick is extremely

well timbered: on every estate of any extent, besides hedge-row timber, there are woods and coppices. At one time the forest of Arden occupied a large portion of the centre of the county. The Stoneleigh estate, which is one of the finest in the county, is extremely well wooded. Some splendid trees might be seen some years ago, and probably remain there still; and also at Ragley, the marquis of Hertford's. The greater part of the soil of the county is peculiarly adapted to the growth of oaks. Coppice-wood is of less value in a district where coal abounds than it would be elsewhere: it is chiefly converted into hoops, hurdles, and hedge-stakes. There are several thriving young plantations, which will keep up the character of the county when the old wood is cut down.

There is no breed of cattle peculiar to the county. The dairy cows are chiefly long-horns, crossed in every possible way: short-horns have been introduced, and are preferred by many, especially for feeding, although the Herefords are in great repute with the graziers; as well as Scotch, when they can be bought in at a reasonable price.

The old Warwickshire sheep is nearly forgotten, having been superseded by the New Leicester and a cross of the two breeds: for folding, the South Downs are preferred.

WEEDS. Every plant which grows in a field other than that of which the seed has been sown by the husbandman is a weed, and, in as much as it interferes with the intended crop, should be carefully eradicated. It is a proof of good cultivation when few weeds appear amongst the growing crops; and many of the operations of tillage are intended chiefly for their destruction. One of the principal uses of summer fallows is to destroy the weeds, which come up in spring, and which would shed their seeds in summer, if they were not destroyed before the seeds ripen. When roots are sown in drills and carefully hoed, they produce the same cleansing effect, and supersede the fallow: but in heavy loams which have been neglected and overrun with weeds, a clean fallow is sometimes indispensable, before any improved method can be adopted. When a farmer enters on lands which are in a foul state, it is the cheapest way, in the end, to sacrifice a crop, and thoroughly purge his fields from weeds, especially those which have vivacious roots, and cannot be extirpated by simple ploughing. The mode of doing this must depend on the nature and duration of the weeds, whether their roots are perennial or die off after the plant has borne seed. Annual weeds are most readily extirpated by repeated harrowings, by which the seeds are brought within the influence of the atmosphere, and when they have fairly vegetated may be buried or rooted out, and by exposing their roots to the influence of a hot sun they are effectually destroyed. The seeds of annual weeds are chiefly brought on the land in the manure which is made in the yards, where the cattle fed on hay or straw swallow the seeds, which pass through them undigested. By exciting a great degree of fermentation in the mixture of dung and litter some of the seeds may be destroyed, but many of them will keep their vegetative powers even after having been exposed to a considerable heat: and, as it is not advisable to let the manure undergo a great degree of decomposition before it is carried on the land, many seeds always escape destruction, and vegetate as soon as they are placed in a favourable situation. Those which are buried deep lie dormant for a long time, and vegetate as soon as the plough brings them up again.

The experienced farmer knows well what peculiar species of weeds infest his fields, according to the soil and situation; and by studying their habits, time of flowering, and of ripening their seed, he learns the best mode of destroying them.

One of the greatest advantages of composts made with human excrements mixed with earths and mineral substances is, that they introduce no weeds into the soil. It is reported that in China, where the dung of cattle is little used, in comparison with human excrements, no weeds are to be found in the fields: and if more attention were paid to the preservation of this highly-enriching manure, and its proper application to the soil, much expense would be saved which is now unavoidably incurred in destroying weeds.

Feeding sheep on roots and corn, while they are folded on the land, is another mode of manuring a field, without introducing weeds, especially if no hay is given them, except clover-hay of the second crop, which is generally most free from the seeds of weeds. It would be impossible to enumerate all the various weeds which may infest our fields. This would be giving a flora of all the British plants; but we will select some of the most common and troublesome to the farmer, with such an account of each as may suggest the most ready means of destruction.

Of the annual weeds we may mention the following noticed by Professor Low in his elements of practical agriculture.

Sinapis arvensis, or Wild Mustard, usually called charlock, is a weed the seeds of which being of an oily nature will remain dormant in the soil for an indefinite time, if buried above six inches. Hence some farmers fear to deepen their ploughings, which otherwise would be very advantageous, because they have found that, in some soils, a ploughing beyond six inches deep will cause the crop to be overrun with charlock so as to choak it with its yellow flowers. It only requires a little resolution, and an outlay which will be well repaid in the end, to destroy this enemy. Hoed crops will destroy the plants as they come up. Winter tares, which may be cut before the charlock perfects its seeds, will help to destroy it, and if they are succeeded by turnips there will be little charlock left in autumn. Wherever it appears and raises its yellow flower it must be pulled out, whatever be the cost, and care must be taken to carry the plants out of the field to burn or rot them; for the seeds will vegetate when they are but half ripe in the pods. We have dwelt at length on this weed, because it is one which infests many of our best soils, and which must be eradicated before the land can be properly cultivated.

Somewhat allied to the last is the wild radish, *Raphanus raphanistrum*, which is often also called charlock,—the mode of destruction is the same.

Papaver Rhœas, or Corn Poppy, infests some soils in particular seasons. If the seed is allowed to ripen and shed it will increase rapidly: good tillage however soon destroys it: clover and tares which are cut while the poppy is in flower generally eradicate it. In some seasons it will appear in great profusion, and in others not a plant will be seen.

Centaurea Cyanus, or Blue-Bottle, is seldom found in any quantity, except where there is a slovenly culture, or two white crops are taken in succession, a practice which, it is hoped, will soon be obsolete.

Chrysanthemum segetum, Corn-Marygold, infests some soils, and must be eradicated by careful weeding; when the crops are drilled, this is not a difficult task.

Pyrethrum inodorum, Corn-Feverfew, often called May-weed, as is also the wild camomile, often infests the crops of corn, and with every care in weeding some of the seeds will be carried to the barn. We may here observe generally, that where the corn is reaped by the sickle and a long stubble is left, the seeds of weeds remain on the land, and although some of them are eaten by birds, yet many are ploughed in after the stubble has been raked off or mown. Whereas if the corn is mown or cut close to the ground, which is called fagging or bagging it, all the weeds are tied up with the corn, and go into the barn or stack: and if care be taken in the winnowing and sifting of the corn to separate the smaller seeds from the straw and burn them in a heap, the straw will be clean and the dung of the cattle will contain no seeds of weeds. This is by far the best mode of proceeding; and by careful hoeing and weeding and burning the small seeds, the land may be kept tolerably free from seed-weeds.

The Sow-Thistle, *Sonchus oleraceus*, often raises its head above the corn. The seeds are blown about by the winds, and if the hedges and headlands are not kept clear of them, they will sow themselves in all directions; but it is a conspicuous plant, and easily pulled out by hand before its flower expands. To destroy thistles, in general, it is only necessary to cut them down just as the flower is expanding; the roots will then die, and in a few years, by the united attention of the farmers in a district, thistles may easily be eradicated. In some places the infirm paupers are employed in pulling up all the thistles in the hedges which border the roads, and wherever they make their appearance in the highways and lanes of a parish. This practice cannot be too generally recommended, for the hedges and ditches and the sides of roads and lanes are often perfect nurseries of weeds.

Arctium Lappa (Burdock), is a very common weed in fields; but with a little care it is easily extirpated.

Agrostemma Githago, or Corn-Cockle, is a very injurious weed, because its seeds ripen about the time of harvest, and from its size cannot be easily separated from the corn by sifting; it contains a farina which is oily and when ground with the corn greatly deteriorates the flour. The only mode of extirpation is by hand-weeding.

Stellaria media, or Common Chickweed, is a small plant which grows abundantly on light soils which have been abundantly manured. If it be allowed to overspread the ground it will choak the young crops, especially turnips, carrots, and all slow-growing seeds. Drilling the crops and early hoeing them is the best means of destroying this weed; as soon as the crop gets above the chickweed, it is soon destroyed, if the latter covers the ground well. It often does harm to young clover, but the latter soon overpowers it. Tares smother it readily. The same observations are applicable to the *Spergula arvensis*, or Corn-Spurrey, a larger variety of which however is cultivated as excellent food for milch cows.

Galium aparine, or Goose-Grass, also called Cleavers, is a weed which is dispersed by the seeds attaching themselves to the wool of sheep by means of hooks with which they are provided. They increase rapidly, in some soils, if they are not carefully pulled up and the hedges cleared of them.

Urtica urens, Stinging Nettles, generally grow where the ground has been strongly manured, especially where heaps of dung have lain. They are seldom very troublesome, and are easily eradicated by repeated ploughing, and infest gardens more than fields.

Polygonum Convolvulus, Climbing Buckwheat, is a very troublesome weed, which winds round the stems of the corn and often overtops them. The seeds are said to be nutritious, and not to injure the oats when mixed with them; but in wheat it is very destructive, and diminishes the product while it injures the quality of the corn.

All the common grasses are weeds in corn-fields, and in the alternate husbandry are introduced in the regular cultivation. When the grass is ploughed up, if the sods are not covered sufficiently so as to rot, tufts of grass remain, which greatly increase, to the injury of the next crop. However carefully the land may be ploughed, if it be sown immediately, the roots of grass will be raised to the surface by the harrows. The only remedy is to have them carefully forked out, and carried to some corner or waste spot, there to form the foundation of a dung-heap or compost. When the land is ploughed up before winter and the seed sown in spring, the grass will be rotten and have lost its vegetative power.

The Bearded Wild Oat, *Avena fatua*, is a very troublesome plant, and sometimes almost exceeds the true oat in quantity: but this can only be the case with very slovenly farmers. It ripens sooner than the corn and sheds its seeds before harvest. Crops, cut green for fodder, such as rye, winter barley, and tares, repeated if necessary, soon destroy this weed, which has no perennial root.

These are some of the most common annual and biennial weeds. They may all be easily destroyed by weeding at the time when they have pushed up their seed-stems and the flower is about to expand; if they are cut up at that time they seldom recover. Hoeing them when very young, unless the weather be dry enough to scorch the roots exposed, often increases them instead of killing them. But the last-mentioned weeds are easily got rid of in comparison with those which have perennial roots, and some of which increase the faster the more the roots are divided. It may be proper to observe that too little attention is paid to the weeds in our upland meadows and pastures. One would imagine that every plant which increases the weight of the hay or covers the ground in spring is wholesome for cattle, whereas many are detrimental when they are eaten for want of better food. Of this kind are the ranunculi, commonly called butter-cups, which, far from deserving this name, are never touched by the cows, so long as they can find other food. Without going the length of ascribing to the butter-cups the power of causing epidemic diseases in cattle, and even in men who eat of the milk and butter of cows who have eaten them, there is no doubt that where the cows are forced by hunger to eat many of them, they may be very injurious to their health and to the production of good milk. As these plants have strong perennial roots, they take possession of rich moist soils to the exclusion of good grasses. When not very abundant the plants may be weeded out by means of a sharp spud or hoe, and the expense will be well repaid in the quality of the hay or pasture. Where they are very abundant the only remedy is to break up the grass in autumn, let it be exposed to the frost in winter, take a crop of corn next season, and lay it rough again the winter after. In the succeeding spring the land may be inoculated with good tufts of grass, and before the next year an improved pasture will have been formed: or, if this is too much trouble, it may be summer-fallowed and sown in August with pure seeds of the best grasses. This is expensive, as a whole year's produce is lost, but the subsequent pasture will be so much better, that the expense may be considered as a profitable investment. The most common species of butter-cup are the *Ranunculus acris*, *repens*, and *bulbosus:* the *R. flammula* is highly poisonous, but not common, except in marshy pastures.

Senecio Jacobæa, or Rag Wort, is another troublesome weed; but as sheep eat it readily when young, it is easily kept down by pasturing and folding. In moist weather also it is easily pulled up by hand.

Tussilago farfara, Coltsfoot. By its large leaves it kills the finer grasses under it. As moisture is essential to its luxuriance, draining tends to diminish its growth, careful manuring also makes the grasses get the better of it, and choak it when young.

Chrysanthemum Leucanthemum, or Great White One Eye, sometimes abounds in inferior pastures, and is only extirpated by tillage and improving the soil by manuring it well.

We have already mentioned annual and biennial thistles, but the perennials, such as the *Cnicus arvensis*, and *Sonchus arvensis*, or Corn-Thistle and Sow-Thistle, are much more difficult to eradicate, as the roots strike deep in the ground and throw up fresh shoots every year. The most effectual mode of destroying them is to draw them out with an instrument like large pincers, made of wood or iron, and called 'a thistle-drawer,' the form of which is well known, and which may be had in most ironmongers' shops. The time to draw the thistles is when the stem is grown sufficiently to give a good hold of the crown of the root. Great care must be taken not to break the root too near the ground, but to draw it out completely. In ploughing also a broad and sharp share, cutting horizontally 7 or 8 inches below the surface, will cut off the long roots so as to prevent their making fresh shoots, and when this is done while the thistle is in a growing state the root will bleed and be destroyed. In grass land they are soon destroyed, if they are carefully cut down with a scythe just as the flower is expanding, and before the seed is formed. If this is done for two or three years, not a thistle will be seen; but then all the neighbouring farmers must agree in a general war upon thistles, whether on the land or in the hedge-rows.

The Dock (*Rumex obtusifolius* and others) is another most troublesome weed both in fields and pastures, and is only to be eradicated by similar means with the thistle. Docks are often left in the field after harvest, where they shed their seed at leisure, whereas they should be collected with as great care as the corn itself, and invariably be burned in heaps: this is the only sure means of destroying the seed. They are often thrown into the roads, supposing that they will be crushed by the wheels of carts passing over them; but it must be remembered, that birds may swallow them, and void them again with their vegetative powers uninjured, if not improved; and that thus they are again sown on the land. Nothing but burning is a sure destruction of the seeds.

Centaurea nigra (Black Knapweed, or Horse-knot) is a coarse plant which chiefly infests pastures, and takes up the room of useful grasses, most animals refusing to eat it. It is only to be eradicated by pulling the plants up by the roots or cutting them close to the ground wherever they appear; manuring the surface highly and mowing the grass soon makes them disappear.

Polygonum amphibium, commonly called Amphibious Persicaria, is found on very wet land, and is best destroyed by draining.

Besides the common couch grass, *Triticum repens*, which is the pest of farmers on light soils, there are a variety of plants which spread both by the roots and by creeping along the surface: of this kind are the different sorts of *quitches*, as they are provincially called, which grow in wet soils; of these the *Agrostis stolonifera*, once so highly praised as fodder under the name of *fiorin*, and the *Agrostis alba* (March bent grass) are the most common; when they take possession of a spot they exclude all other grasses. The only mode of extirpating these last is draining and careful tillage. But to return to the common couch. This weed sometimes takes such possession of the soil that nothing else can thrive in it. It is not a single fallow or cleaning which will get rid of it, but a regular system. Ploughing does often more harm than good by dividing the root (which is in fact an underground stem), and thus increasing the number of plants. The most effectual means of destruction is by the fork. If after the ground has been once ploughed it be forked up carefully in dry weather, and the tufts of couch with their roots be exposed to the hot sun, they may be raked off and burnt; but as these roots contain much nutritive saccharine matter, it is often worth while to wash them, if the adhering earth cannot be beat out, and to give them to horses and cattle to eat, taking care that the litter and dung made at that time be reserved to manure grass land and not arable fields. Heaps of couch may be rotted by pouring urine or the drainings of dunghills over them; and if they are frequently turned will produce a rich compost. Any inconvenience from the extreme vitality of the roots is obviated by using this compost mixed with earth as a top-dressing for pastures.

Another weed with perennial and very vivacious roots, is the *Arrhenatherum avenaceum* (Common Oat-like Grass). The root is bulbous, and the bulbs separated grow again. It is difficult to eradicate, but the means employed to get rid of the couch grass will succeed with this and most other perennial roots. These troublesome weeds may have been wisely dispersed through the soil by Providence, to induce the cultivator to give his land a more perfect tillage than he might have done otherwise. The expense of forking, and what is usually called couching, is generally amply repaid by the finer tilth it gives to the land, and the crops are more certain and abundant in consequence.

There are many other weeds both in arable and pasture land which indicate slovenly culture, and which disappear on careful cultivation: such as briars, furze, broom, and rushes; the last being a well-known sign of superabundant moisture, and only to be destroyed by under-draining. The whole process of cultivation is a continual struggle between the farmer and the weeds natural to the soil he cultivates. The sooner he subdues them entirely the less will be his subsequent trouble; and the perfection of agriculture is to produce crops of such vegetables as are useful and profitable, and are suited to the soil which is cultivated, while all others are excluded which might interfere with the crops to be raised. That much remains yet to be done in this respect on farms which are looked upon as models of cultivation, will be acknowledged on simple inspection. The almost universal adoption of the system of drilling and hoeing the crops tends greatly to the destruction of useless plants on arable land; much yet may be done by way of improving the produce of meadows and pastures by the destruction of all noxious and useless plants, and the introduction of those which are nutritious and improve the herbage, whether depastured or made into hay; and nothing is so likely to do so as a good system of alternate husbandry, where the best grasses are cultivated as carefully as the plants which are immediately applied to the food of man.

WESTMORELAND AGRICULTURE.—Although this county, from its mountainous nature, is more interesting in a picturesque than in an agricultural point of view, it contains some very fertile valleys, in which there are as many well-cultivated farms. The climate is mild and moist in the valleys: the high hills condense the clouds which come over the Atlantic, and cause frequent and abundant rains, which keep the pastures green, but are not so favourable to the ripening of the corn. Much snow often accumulates in winter. The greater part of the surface of this county, which is reckoned to contain 450,000 acres, is mountainous, and only fit for sheep-pastures or for plantations of timber-trees. Dr. Watson, late bishop of Llandaff, who was a native of this county, took much interest in the increase of woods, and made many calculations on the profits of planting, which appeared to offer great advantages to those who would engage in this speculation, and he showed a good example by making many extensive plantations on the sides of barren hills which he had purchased.

The soil in the valleys is mostly a dry gravelly mould, composed of different earths washed down from the hills, and forming a soil well fitted for the cultivation of turnips, of which great crops are raised on some well-managed farms. Towards the east and north of the county the soil is more inclined to clay; and, unless this be well drained, the land is too wet, in spring and autumn, to admit of clean and careful cultivation. Wherever the water has no sufficient outlet, basins of peat are formed; but these are not so extensive as they are in many other hilly countries, owing to the calcareous rocks which form the substratum of a great part of the hills, and which, being porous, prevent the accumulation of water, except in those parts where they form the lakes which make this county so interesting to travellers.

There were formerly a great many small proprietors in Westmoreland who were called *Statesmen*, that is, *Estatesmen*,—men who held land of their own, either as freehold, or by a customary tenure, somewhat resembling copyhold, under some great landlord. With the exception of a fine or heriot on the death of a tenant or on alienation, they were held free. The proprietors of these very small farms were an independent set of men, who worked hard and lived frugally. They often joined the trade of weavers to that of farmers; and thus their whole time was usefully employed. The increase of wealth and consequent luxury gradually led to a greater expense of living than the small farms, imperfectly cultivated, could support; and these small proprietors gradually decreased, their farms being absorbed into the greater estates which surrounded them. The larger farms are now usually let on lease for various terms. In some old and many new leases the course of cropping is strictly laid down, which greatly hampers a good farmer in his wish to improve the cultivation. It is to be hoped that more liberal views may yet be taken by the present agents and proprietors, and a greater scope given to improvements. Draining the heavy lands has been of late years much attended to; and in no county is it more beneficial than in this, where the rains are so abundant that the evaporation from the surface of the soil can never keep it in a dry state, if the subsoil is retentive of moisture.

The implements of husbandry were originally very simple and not of the most improved forms, but increased communication by means of good roads, and the influx of visitors attracted by the beauty of the scenery, have contributed much to introduce every improvement on those farms which are the property of men of fortune and occupied by tenants who have sufficient capital. These however are not so numerous as it were to be desired for the improvement of the farms. A considerable portion of every farm is in pasture, which is rich in the valleys and fit for milch cows, moderate on the slope of the hills, and very poor on the mountains: some rough cattle are reared, and many mountain sheep feed on the hills. These often suffer much from the severity of the winter; but, as they cost little to keep, an occasional loss is not much thought of. Perhaps with a little more attention this might be avoided.

The old system of cultivation was very simple: when the pastures became mossy, owing to the wetness of the climate, they were ploughed up; one or two crops of oats were taken, after which they were well manured and sown with barley, then oats again, when the land was left to run to grass, which it did in about three years. It remained in pasture for five or six years longer, when it became mossy again, and was again broken up and ploughed as before. This alternate husbandry was not expensive; but by the introduction of turnips and clover in the rotation the land has been made to produce a much greater return, while it has been gradually improved; and by sowing good grass-seeds the produce has been much increased in value, while the herbage is more free from natural weeds.

From Kirkby Stephen to Brough and Appleby, and thence to Temple Sowerby, the soil is a deep sand, which in a dry country would be very unproductive; but which the moisture of the climate of Westmoreland renders more compact on cultivation. Turnips and potatoes grow well here, when plenty of manure is put on. Lime is a great improver of the soil, and fortunately abounds in the county. Near Kendal a great breadth of potatoes is planted for the supply not only of the immediate neighbourhood, but also of the adjacent counties, many thousand loads being annually sent into Lancashire and Yorkshire.

The heavy lands were generally cultivated on the old system of oats, barley, oats, which by the help of the manure raised from the pastures, and before improved rotations were introduced after draining and deep ploughing, was perhaps the most profitable course. The cultivation of heavy wet lands is so much more precarious than that of the lighter, that they have not had so much attention bestowed on their improvement as the light turnip soils. Of late these lands have been found susceptible of as great improvement, by thorough-draining; the crops are found not only more abundant, but also more certain; and the inconvenience of not being able to plough and work these soils in spring is obviated by the perfect draining. When this system is more generally adopted on heavy soils, it will be found that the present disinclination of farmers to take farms on such soils will cease, and give place to the more antient predilection for heavy lands, which will bear wheat and beans with little exhaustion.

The cultivation of flax and hemp, which was very common formerly, has now been long discontinued, owing to the competition of the foreign growers: but if ever the present protection given to the growers of corn be removed by an alteration in the corn-laws, the comparatively unprotected produce, such as flax and hemp and linseed, will, no doubt, draw the attention of the farmers again.

Grass land being abundant and the climate favourable to pastures, a great portion of the soil is devoted to the maintenance of cattle. Good meadows let at a high rent, and are carefully manured with composts. Great crops of hay are made in favourable years, and, as those who keep horses generally hire a meadow to make hay of, it is seldom sold in the dry state. Young cattle are kept on inferior lands in summer, and have hay and straw in winter, with turnips, where these are raised: a few are fatted at three years old, but most of them are sold to graziers in Yorkshire and Lancashire. Scotch cattle are purchased in September, at the great fair at Brough-hill, held in that month: they are wintered in coarse pastures and occasionally in straw-yards; the next year they are put on the best grass, and are fit for the butcher in October. A few horses are reared, but not to any extent. The sheep are of a hardy kind, fit for the mountain-pastures; they are brought down to the valleys at the approach of winter and kept in the enclosed grounds till April. The folding of sheep on turnips is not so general as it ought to be, especially on the gravelly and sandy soils. The goodness of the farming may generally be judged of by the extent of land on which turnips are raised to be eaten on the land by sheep. The plantations are extensive in most parts of the county.

The bishop of Llandaff, as we mentioned before, made considerable plantations of oak, ash, elm, beech, sycamore, Scotch fir, and larch, which last have thriven best. Many ornamented cottages and small villas have been built on the borders of the several lakes; and men of talent and reputation have taken their temporary and some their permanent abode there. This has tended to improve the immediate neighbourhood more rapidly than would otherwise have been the case. Yet this improvement seldom extends far from the centre where it commenced; and much land remains unproductive, of which the value might be greatly raised by a judicious outlay of capital, either by planting or by cultivation. Draining can be effected at a small expense, where stone is so abundant: lime is cheap, and labour reasonable: with these means many a spot now covered with heath might present to the view of the traveller cultivated fields. If something should be lost in picturesque scenery, much would be gained in usefulness; and the intermixture of well-cultivated farms and barren rocks would not render the scene less interesting.

The fattening of hogs and the curing of bacon and hams are well understood in Westmoreland, and many hams are sent to other parts of the country. The breed is not large. The hogs are not made so fat as they are in some places; the hams are more delicate, and are very well cured and smoked. They are often sold as York hams, whereas the latter are much larger and fatter, the Yorkshire breed of hogs being large and fattening very readily. Although the curing of hams is tolerably well understood in most places, it may be useful to state the mode in which they are cured in Westmoreland. They are rubbed over very hard with bay-salt, and laid in a stone or leaden trough. Every third or fourth day they are turned and rubbed with the brine which has run out, and with fresh bay-salt mixed with a little saltpetre. A more modern and generally used plan is to lay the hams on an inclined plane after covering them with bay-salt, and to allow the brine to drain off into a vessel placed to receive it. Some add treacle or brown sugar, which gives a peculiar flavour. In three weeks they are fit to be hung in a wide chimney, where wood is burnt on the hearth. Saw-dust kept burning slowly without flame is as good as wood to smoke and dry the hams. When they are sufficiently dry they are sewn up in coarse linen cloths, and packed in hogsheads or put into sacks. They lose 20 per cent. of their weight in curing and drying.

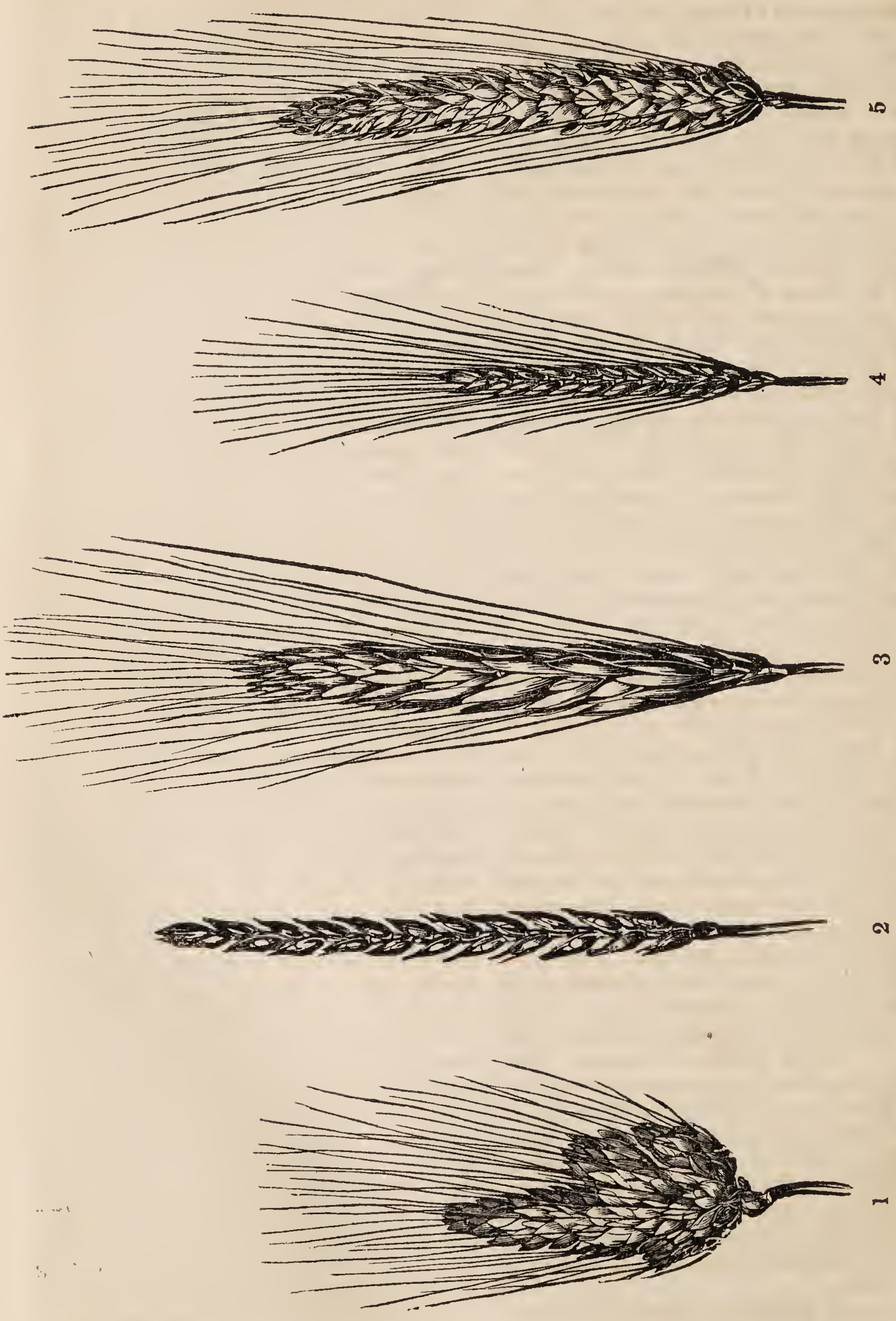
WHEAT. Of all the plants which are cultivated, there is none of more importance than wheat. It grows readily in almost every climate from the torrid to the frigid zones. A temperate climate, such as is best suited to the nature of man, seems to be its natural home. It has been so long cultivated, that where it appears to grow spontaneously, as in some uncultivated spots in the East, it is doubtful whether it be not the remains of wheat antiently cultivated there. It is an extremely hardy plant, and its vitality is such that it is not easily destroyed. Wheat has been known to be covered with the water of floods so long, that every other remnant of vegetation was destroyed; and yet, on the waters retiring, it has sprung up from the root and come to perfection: it has also been found in Egyptian tombs, and, if the statements are true which have appeared in the ‘Doncaster Gazette’ and other publications, it has grown when planted.

The botanical characters of wheat, the scientific name of which is *Triticum*, are not described here. Some botanists have divided wheats into different species, from some marked peculiarity in their formation. Others, considering that they mostly form hybrids when mixed in the sowing, and that their peculiarities vary with the soil and climate, have looked upon all the cultivated wheats as mere varieties. There are however three principal varieties, so different in appearance that they claim peculiar attention. These are the hard wheats, the soft wheats, and the Polish wheats. The hard wheats are the produce of warm climates, such as Italy, Sicily, and Barbary. The soft wheats grow in the northern parts of Europe, as in Belgium, England, Denmark, and Sweden. The Polish wheats grow in the country from which they derive their name, and are also hard wheats. It is from their external form that they are distinguished from other wheats. The hard wheats have a compact seed nearly transparent, which, when bitten through, breaks short, and shows a very white flour within. The soft wheats are those usually cultivated in Britain; they have an opaque coat or skin, and which, when first reaped, give way readily to the pressure of the finger and thumb. These wheats require to be well dried and hardened before they can be conveniently ground into flour. The Polish wheat has a long chaff which is much longer than the seed, a large oblong hard seed, and an ear cylindrical in appearance. It is a delicate spring wheat, and not very productive in the climate of England: hence it has only been occasionally cultivated by way of experiment.

The following cuts represent some peculiar varieties of wheat. The first is a compound ear, produced by very luxuriant vegetation, and is common in Egppt. The second is the spelter wheat, of which the chaff is so strongly attached to the grain as to be separated only by passing through a mill. It is an inferior variety, but grows in less fertile soils. The third is the Polish wheat, with very long chaff and hard grains. The fourth is a variety which only ripens one seed in each spikelet, and is not much cultivated. The fifth is common soft bearded wheat. If the awns of this kind are obliterated, it forms our common soft wheat. The circumstance of awns seems not to affect the nature of the wheat, and they differ so much in length that the varieties of smooth-eared and bearded wheats run insensibly into each other.

The hard wheats contain much more *gluten*, a tough viscid substance which is very nutritious, and which, containing a portion of nitrogen, readily promotes that fermentation, or *rising*, as it is called, of the dough, which is essential to good light bread. The quantity of this varies with the soil and climate, from 5 per cent. in some soft wheats to 30 per cent. in the hardest and most transparent. It is this quantity of gluten which causes the Italian wheats to be used exclusively for the rich pastes which form so large a portion of the food of that nation. The soft wheats contain the greatest quantity of starch, which fits them for the vinous fermentation, by its conversion into sugar and alcohol: for brewing or distilling, therefore, the soft wheats are the best.

The distinction between the winter and summer wheats is one which arises entirely from the season in which they have been usually sown; for they can readily be converted into each other, by sowing earlier or later, and gradually accelerating or retarding their growths. The difference in colour between red and white wheats is owing chiefly to the soil; white wheats gradually become darker and ultimately red in some stiff wet soils, and the red wheats lose their colour and become first yellow and then white on rich, light, and mellow soils. It is remarkable that the grain sooner changes colour than the chaff and straw. Hence we have red wheats with white chaff, and white wheats with red chaff, which on the foregoing principle is readily accounted for. The chaff retains the original colour when the skin of the grain has already changed to another. We state this on our own experience. The soil best adapted to the growth of wheat is a deep loam inclined to clay, with a dry subsoil. If this is not so naturally, it must be drained artificially, to ensure good crops of wheat. In such a soil, wheat may be sown every third year, with proper intermediate crops. Formerly the preparation for a wheat crop was generally by a clean naked fallow, with a certain addition of manure, the remains of which were thought sufficient for a crop of barley or oats; after which the fallow recurred. It was soon found out that, by this means, a crop of wheat could never be forced beyond a certain average; for if more than the usual portion of manure was carried on



1, Egyptian Wheat (Triticum Egyptiacum); 2, Spelter Wheat (Triticum Spelta); 3, Long-chaffed Polish Wheat (Triticum Polonicum); 4, Singled-grained Wheat (Triticum monococcum); 5, Common Bearded Wheat (Triticum turgidum).

the land, the wheat failed, by being laid before it arrived at maturity. Thus a limit appeared to have been set to its increase. New modes of cultivation have shown that this was not without its remedy, and that it was recent manuring which caused the wheat to lodge; but that an increased fertility, produced by judicious preparation, enabled the land to bear crops of wheat far superior to what it ever could before. Wheat requires a soil in which the organic matter is intimately mixed with the earthy ingredients; where it can have a firmer hold by its roots, and can at the same time strike the fibres of them downwards as well as around, in search of food. When it meets with such a soil and is deposited at a proper depth, it vegetates slowly, pushing to the surface one cylindrical filament, while numerous fibres strike into the soil from the seed. These supply the plant with regular nourishment, and in due time a knot is formed at the surface of the soil, from which several roots and stems branch out. This called the tillering of the wheat. The new roots near the surface soon become the chief source of nourishment, and in a rich compact soil, where there is room, numerous stems arise, forming a tuft, and each of these in time bears a large ear well filled with seeds; so that from a very moderate quantity of seed a great return is produced. The strong stems supporting each other are well able to resist the effect of storms and rains, which would lay weaker plants level with the ground. The effect of abundant manuring immediately before the seed is to produce too rapid a growth, weakening the straw, and increasing its quantity at the expense of the ear, which does not attain its proper development. This is called running to straw. All strong manures which contain many saline particles have this effect; which is corroborated by late experiments with saltpetre, nitrate of soda, and other saline compounds. They produce more straw and less corn, and hence are not found of the same use, when applied to crops which are cultivated for their seed, as they are on grasses.

A certain portion of nitrogen is essential to the production of good wheat, as that element enters into the composition of the gluten, which will be found to abound in proportion as nitrogen exists in the soil, or can be supplied from the atmosphere. The experiments of Liebig seem to show that the nitrogen of the atmosphere will not enter into the substance of plants, except in the form of ammonia, and hence the efficacy of manures has, of late, been estimated by the quantity of ammonia which they can produce. This theory however requires to be confirmed by experience, before it is at once adopted without limitation. Decayed vegetable matter, or humus, seems essential in a good wheat soil, and it may, in the slow progress of its entire decomposition, when it is continually absorbing the oxygen of the air, have some chemical effect on the nitrogen also, so as to make it of use in the vegetation, whether by first forming ammonia, or in any other way. Further experiments may perhaps throw a light on this subject. It is well known however that, provided a soil be compact, its fertility is very nearly proportioned to the quantity of humus which it contains, especially if there be calcareous earth or carbonate of lime in its composition. Lime has been often considered as the most efficacious manure for wheat, even more than dung. As long as there is organic matter in the soil, lime acts beneficially; and the richer the land which does not contain carbonate of lime already, the more powerful the effect of liming. But experience has proved that lime has little effect on poor soils, until they are first manured with animal and vegetable substances. To produce good wheat, then, the land should be gradually brought to the proper degree of fertility, by abundant manuring for preparatory crops, which will not suffer from an over-dose of dung, and will leave in the soil a sufficient quantity of humus, intimately blended with it, for a crop of wheat. Clover is a plant which will bear a considerable forcing, and so are beans, and both are an excellent preparation for wheat. The roots left in the ground from a good crop of either decay slowly, and thus furnish a regular supply of food for the wheat sown in the next season. Potatoes also admit of much forcing, but the necessary loosening of the soil for this crop renders it less fit as a preparation for wheat. Experience has fully proved that, as a general rule, it is better to sow barley and clover after potatoes, and let the latter be succeeded by wheat.

Improved chemical analysis has discovered various substances in minute quantities in the grains and straw of wheat; and this has led to the doctrine that these substances, being essential to its formation, must be excellent manures for it, if they do not already exist in the soil in sufficient quantities. Most of these substances are found in all soils which contain a due proportion of clay. Silica in a very minutely divided state, and probably in combination with alumina or potass, seems one of the most important to give due strength to the straw ; and hence in some soils potass or wood-ashes which contain it may be advantageously used as manures to the young clovers preceding the wheat. The analysis of the ashes of grains of wheat chosen out of the ears, by Theodore de Saussure, who is generally considered an excellent authority, gives the following results:—

Potass	15
Phosphate of potass	32
Muriate of potass	0·16
Sulphate of potass, a trace.	
Earthy phosphates	44·5
Silica	0·5
Metallic oxides	0·25
Loss	7·59
	100·

The analysis of the ashes of the straw gave the following result:—

Potass	12·5
Phosphate of potass	5
Muriate of potass	3
Sulphate of potass	2
Earthy phosphates	6·2
Earthy carbonates	1
Silica	61·5
Metallic oxides	1
Loss	7·8
	100·

The analysis of the ashes of the whole plant, when in blossom, gives of—

Soluble salts	41
Earthy phosphates	10·75
Earthy carbonates	0·25
Silica	26
Metallic oxides	0·5
Loss	21.5
	100·

By comparing these results it will appear, that from the time of flowering to the maturity of the seed a portion of the soluble salts is converted into earthy phosphates; that silica accumulates in the straw, but not in the grain: and as potass is the principal means of rendering the silica soluble, it is an important ingredient in a wheat soil, as well as the phosphoric acid. This last is found chiefly in animal manures.

Although wheat thrives best on heavy soils, and without due preparation produces only scanty and uncertain crops in those which are naturally light and loose, it may be made to give a very good return in soils which would once have been thought fitted only for the growth of rye and oats. But then the texture and composition of these soils must have been greatly improved by judicious tillage and manuring. While the heavy soils are repeatedly ploughed and pulverized to render them mellow, the lighter are rendered more compact by marling, where this can be readily done, by adding composts in which the principal earth is clay, and especially by such plants as have substantial and long roots, by which the soil is kept together, such as clover, lucern, sainfoin, and other grasses. If these plants have been well manured, and cover the ground well, keeping in the moisture, the soil will have become sufficiently compact to bear wheat. One ploughing is then quite sufficient, and if a heavy land-presser is made to follow two ploughs and press in the furrows, so as to leave deep smooth drills eight or nine inches apart, in which the seed can find a solid bed, there will be every probability of a good crop of wheat, which will come up in regular rows, the roots being at such a depth as to run no risk of wanting moisture till the stem has arisen to its full height, and the ear is formed: a few showers at that critical time will make the grain swell, and insure a good crop.

On some soils it may not be judicious to attempt to sow wheat; but these are the poorest loose sands, which naturally would bear only oats and buckwheat; on these, unless they can be abundantly marled, it is much better to sow rye. When wheat is sown on light soils in good heart, it grows vigorously in spring, if it has not been injured by the frost, which is very apt to raise up the roots and throw them out of the ground. The driving of sheep over the field presses the roots into the ground, and prevents this throwing out; but a vigorous growth of straw is not always a sure sign of a good crop at harvest, as many farmers know by sad experience; what would be advisable in heavy soils is not always so in lighter. A heavy rolling in spring after a light harrowing is very useful at a time when the surface is moist. It closes the pores and checks the evaporation: and the tighter the surface can be made the better chance there is of a fair crop. The Norfolk rotation, as it is generally called, in which wheat is sown after clover, is the only one well adapted for wheat on light soils. The manure having been put abundantly for the turnips, and the land being freed from weeds, the barley which follows is generally a good crop; and the clover, which is sown in this, is trodden in the reaping and carrying of the barley: and there is only one ploughing from the time the barley is sown to the sowing of the wheat. If this be dibbled on the turned sward of the clover, the land will receive another treading by the dibblers, the seed will be regularly deposited at a proper depth, and no preparation of light land can be more likely to produce good wheat. On heavy soils the process must be varied; the surface, instead of being rendered more compact, will often be so bound as to require to be stirred by harrowing or hoeing before the wheat plant can properly tiller. If a farmer is anxious to have good crops of wheat, he must not rest satisfied after he has ploughed, manured, and sown: he must watch the growth of this important crop daily, and use the means which experience and observation have suggested to assist the growth and to remove the causes of failure.

In heavy soils nothing is more detrimental than excess of moisture. Even in well-drained fields the water will stand too long in the furrows if there is not a proper outlet for it. The furrows should be well cleared out with the spade as soon as the seed is sown, drilled or dibbled, the earth being thrown evenly over the surface of the stitches, and not left in an unsightly ridge, which crumbles down with the furrow at the first frost. In proper places and at regular distances deeper water-furrows should be dug out after the plough has ploughed a deep furrow in the intended line; and this should then be finished as is said above: so that if a heavy fall of rain should come suddenly, the water will have a regular course and outlet into the ditches which lie in the lowest part of the land, without soaking into the soil, which is already too retentive of moisture. It is chiefly in spring and when snow melts that there should be a daily inspection of the wheat-fields. An experienced eye going along the bottom of the ridges of a large field will discover at once whether there is any stoppage of the water; and by means of a spade or shovel it will be remedied with little trouble. When the surface binds, as it does in some soils, and prevents the access of air to the roots, the land is harrowed or hoed, and in a few days the effect will be apparent.

Soils which lie on a very porous subsoil, or which by artificial draining have been so dried and mellowed that horses can go over the land at all times, without making such an impression as will retain water if it rains, may be laid flat, without more open furrows than is necessary for the convenience of ploughing with a fixed turn-furrow; and thus a considerable portion is made productive which would be taken up by furrows, and perhaps produce weeds. But if the soil is of a tenacious quality, easily compressed when moist, and horses cannot safely be allowed to pass over it when wet, it is absolutely necessary to divide the land into stitches, or beds with furrows between them, in which the horses can walk while they draw harrows or any other implement over the land. All the implements should be so constructed that, if they have wheels, these may run in the furrows, so that nothing will disturb the evenness of the stitches, which should have a very gentle slope from the centre towards the two furrows which bound it. For spring crops this is not so essential, although it is advisable not to deviate from the usual form, even when barley and clover are sown, because, when the surface is laid in double stitches, as is sometimes done, it is not very easy to lay it in narrow stitches again, at one ploughing, for wheat. No doubt a very expert ploughman would do so, but it is not often that many expert ploughmen are on the same farm. Even in very light soils, as in Flanders, narrow stitches with deep intervals are thought most advantageous.

It is a very common notion that good wheat and bean land is not well adapted to the growth of roots, especially of such as are usually fed off the land by sheep, because the treading of animals is injurious in winter and spring, when these crops are usually wanted; and if they are carted off, the wheels and the horses make such impressions as are equally detrimental, or more so. But all roots, even the white turnip, will grow luxuriantly on heavy soils well prepared and manured; and they may be so managed as to be taken off before the winter, or even very soon after wheat harvest. The bulbs will not be so large, but they will be more succulent, and may be kept in various ways till they are wanted for the cattle. The land being ploughed immediately on the removal of the turnips, will be well prepared for wheat, or, when mellowed by the winter's frost, may be sown in spring with beans, barley, or oats. The manure will be incorporated with the soil, even if it has been put on in a very fresh state for the roots, which can only be recommended on very compact soils. If the root crops are well cleaned, fallows may be avoided, or, at least, recur very seldom, and then only when root weeds have accumulated from neglect.

When the wheat has blossomed, and the grain in the ear is fully formed, it should be watched, and as soon as the seed feels of the consistence of tough dough, and the straw is dry and yellow below the ear, it should be reaped. The skin of the grain will be thinner, and its substance will harden readily by mere drying, while the straw is better fodder for the cattle. It is found by experience that the increase of flour by adopting this method is very considerable.

It was the custom of our forefathers to cut the straw half-way between the ear and the ground, and their reason was, that thus less room was required in the barn, and no seeds of weeds were carried there in the straw: but the loss of half the straw, which might have afforded litter or fodder for cattle, was overlooked: and if the weeds were not taken into the barn, where they could do little harm, except giving a little more trouble in winnowing and sifting the corn, they were left to shed their seeds on the land, and thus perpetuate its foulness, or add much to the labour of weeding the succeeding crops. The stubble or halms had to be mown or raked off before the land could be well ploughed, and although this might make a very good shelter for cattle in a yard, when made into halm-walls, as they are sometimes called, there was a great loss of labour in thus going twice over the field. The most approved mode of reaping now is that which is called fagging or bagging in Middlesex and Surrey [Harvest], but the most expeditious is mowing, which, by means of a cradle-scythe, may be done so regularly as to allow all the corn to be tied up in sheaves without any loss. The weeds are tied up with the corn, and when the whole is thrashed, the seeds of the latter are winnowed out and burnt: thus they cannot infest the land, and there is double the quantity of straw to convert into manure—a matter of great importance where cattle are fed on turnips in the yard, chiefly for the sake of their dung.

The choosing of wheat for seed is a matter of great importance. Some farmers like to change their seed often; others sow the produce of their own land continually, and both seem persuaded that their method is the best. The fact is, that it is not always the finest wheat which makes the best seed; but it depends on the nature of the land on which it grew. Some soils are renowned far and wide for producing good seed, and it is well known that this seed degenerates in other soils, so that the original soil is resorted to for fresh seed. Many places have been noted for this peculiarity; and among them we may mention the parish of Burwell, in Cambridgeshire: the wheat which grows there is mostly sold for seed at a price considerably above the average. It has been asserted of late, and we have no reason to doubt the assertion, that the various noted seed-wheats, when analyzed, are found to contain the different elements of which they are composed in nearly the same proportion, especially the starch and gluten. For bread, that which contains most gluten is preferred, as we observed before; but to produce a perfect vegetation, there should be no excess of this substance, nor any deficiency. The seed also should have come to perfect maturity. This last is usually obtained by beating the sheaves over a block of wood or a cask, without untying them, by which means the ripest seeds fall out. The proportion between the starch and gluten is easily ascertained by carefully washing the flour when the wheat has been ground. It is most convenient to tie up the flour in a cloth, which, shaken and beaten in water, will let all the starch pass through, and retain only the gluten. The operation should be continued as long as the water is tinged with the white starch. Any one can readily make the experiment; and as the soft wheats vary much in the proportion of the gluten they contain, the difference will be readily ascertained. This leads to a practical conclusion: if we wish to grow any peculiar sort of wheat for seed, and if we find that, by our preparation of the soil, or its original composition, we produce a wheat in which the gluten and starch are in a different proportion from that of the original seed, we may conclude that this is owing to more or less of azotized matter in the soil, that is, more animal manure, or more vegetable humus; and by increasing the one or the other, we may bring our wheat to have all the properties of the original seed. This is a valuable discovery, and deserves to be fully confirmed by experience.

While the wheat is growing it is exposed to various accidents, which it is often difficult to foresee, and more difficult to guard against. The smut and burnt-ear are diseases which may be generally prevented by a proper preparation of the seed before it is sown. [Burnt-Ear; Smut.] Many corrosive substances have been recommended to steep the seed in, such as blue vitriol and arsenic, and those who have used these steeps place great confidence in them. It seems however that washing the seed well with plain water or with salt and water, and afterwards drying it with quick-lime, sufficiently destroys the germ of the smut to prevent its propagation. The most common steep is water in which so much salt has been dissolved as will enable it to float an egg. In this the seed may be left for 12 hours or more, and then spread on a floor and mixed with as much quick-lime as will absorb the moisture, and allow it to be sown or drilled, without the grains adhering to one another.

In the second volume of the 'Journal of the Royal Society of Agriculture of England,' Part I., is a valuable paper, by the Rev. T. S. Henslow, on the diseases of wheat. He describes the different *fungi* which produce the various diseases of pepper-brand, dust-brand, rust, and mildew: he doubts the truth of the assertion that Berberis trees or bushes cause mildew in wheat which grows near them, although this is believed by many farmers.

The ergot in wheat is an excrescence from the ear, like a small horn, into which the seed is transformed. It has a poisonous quality and a medicinal one. The cause of this monstrosity in the seed is not fully known. It is supposed to be caused by the puncture of some insect, introducing a virus which has entirely altered the functions of the germ, and made it produce this ergot, instead of a healthy seed.

Another disease of the seed is called ear-cockles, and is caused by extremely minute insects like eels, which fill the skin of the seeds instead of flour. This insect, which is called *Vibrio Tritici*, is described by Mr. Bauer in the 'Philosophical Transactions' for 1823. This disease is not so common as the smut and pepper-brand. It is probable, according to Mr. Henslow, that the animalcula may be killed by exposing the grain to a certain heat, so as not to destroy its power of vegetation, but sufficient to kill the vibrio.

The wheat-midge (*Cecidomyia tritici*) is another external enemy, which does more harm to the crop than is generally known. It deposits its eggs at the root of the germ in the ear, and prevents the filling of the grain, the maggot living on the nutritive juices which should produce the farina. The Hessian fly, which caused such depredations in America and Canada at one time, is a different species of the same fly. This deposits its eggs in the straw near the root, and thus destroys the whole plant. We must refer the reader for further particulars to the paper above mentioned. Great attention has been lately paid to the introduction of the best and most prolific varieties of wheat, and by merely observing what ears appear much superior to others in a field of ripe wheat, and collecting these to be sown separately in a garden or portion of a field, the variety, which may have been produced by some fortuitous impregnation, or some peculiarity in the spot where it grew, is perpetuated. By carefully selecting the seed which is best adapted to the soil, by a more careful and garden-like cultivation, and by adding those manures which are found most adapted to favour its perfect vegetation, crops of wheat have been raised which, at one time, would have been thought miraculous; and the average produce of this important grain has been increased on all soils. When we consider how closely this is connected with the welfare of a nation, we must be grateful to those who devote themselves practically and theoretically to the increased production of this staff of life.

WILTSHIRE AGRICULTURE.—In an agricultural point of view the county of Wilts may be divided into two districts, the first or southern district comprehending all the Wiltshire Downs, with their intersecting valleys, and separated from the northern by an irregular line running round the foot of the chalk-hills from their entrance into the north-east part of Berkshire to their south-west termination at Maiden Bradley. We shall therefore consider these districts separately.

South Wiltshire Agriculture.—South or more properly South-East Wiltshire contains, in round numbers, about 500,000 acres of land. The Downs are an elevated table-land intersected by valleys, which give the surface a broken appearance. These valleys contain rivers and small streams. The soil being generally more fertile there, and the climate milder, cultivation was originally confined to them; and there most of the villages are situated: the higher and more exposed situations remain as natural pastures for sheep and cattle.

The air on the Downs is keen, and healthy to robust constitutions. The valleys, although more sheltered from the sweeping winds from the Atlantic, partake of this keen air, which is drawn along their course in currents.

The soil on the Downs varies little, being thin, and uniformly resting on the chalk. It produces excellent short herbage, very well suited for sheep pasture; and where it has been broken up, it is only by great skill and very careful cultivation that it is made to repay the cost. It is comparatively a small proportion which has been converted into arable land, and chiefly on the borders of the valleys; the cultivation but extends upwards in consequence of the demand for corn offering temptations to the proprietors and farmers to increase the quantity of land devoted to its growth, and the extent of pasture affording the means of folding sheep on the arable land, and thus increasing its fertility. As we descend from the Downs into the valleys, the soil generally becomes less mixed with flints and of a more loamy nature, in consequence of the waters washing down portions of the upper soil, of which the finer particles are deposited on the sides of the hills, and form what is called white land. The level part of the valleys nearest the rivulets consists of flints washed down lower, and mixed with fine earth. In some places there is a kind of peat, the formation of which is evidently owing to the stagnation of the waters in pools which have not had sufficient outlet; but these spots are not numerous.

Some remarkable veins of sand intersect this district; one of these, of a fertile nature, enters the county at Mere on the borders of Dorsetshire, and takes a north and north-east direction round the outer edge of the Downs, keeping nearly close to their foot, by way of Maiden Bradley, Warminster, Westbury, and Lavington, towards Devizes, where it meets with a much wider and still more fertile vein coming down the Pewsey vale from Burbage. Another vein also enters the county from Dorsetshire, being a continuation of the sand-hills on which Shaftesbury stands, and passes through Donhead, Ansty, Swallowclift, Fovant, &c., under the foot of the Downs, till it is stopped by the high ground in Burcombfield. This vein is also met at or near Fovant by another branch, or rather a ridge of sand-hills, coming from West Knoyle by Stop-Beacon and Ridge. These are the principal soils in this division; and although there are some spots of a more clayey nature, they are not extensive. (See the *Report to the Board of Agriculture*, by Thomas Davis.)

The system of cultivation was originally such as the situation of the more fertile soils and their connection with the extensive pastures on the Downs naturally suggested. Wool was, no doubt, the principal produce; and no more corn was grown than the necessity of the inhabitants required. The estates or manors extended in narrow strips along the valleys, and had certain rights of common and wood attached to them. These were let whole, or more commonly subdivided, and the arable land lay in common fields, in divisions and patches, which precluded any system of cultivation which was not adopted by general consent. This is the history of all common fields. Folding sheep on the land was the great resource; and the numerous streams suggested artificial irrigation, by which hay was increased for winter-feed and early grass for the lambing season. In no part of England, as we shall see hereafter, was the system of water-meadows introduced so early or carried to such perfection. In fact it became one of the chief features of the agriculture. A farm consisted of certain buildings and homesteads, with meadows, irrigated if possible, or kept in heart by folding; with some fields to raise corn for the family, and a run on the Downs for a certain number of sheep, which were the chief source of rent and profit. Since the common fields have mostly been enclosed and divided among the proprietors, more land has been cultivated and better systems adopted; but this has been done slowly, the old methods retaining a certain sanctity in the eyes of the farmers, who are not easily brought to depart from what they have seen their fathers do before them. A great and gradual improvement however has taken place, and new methods are daily introduced, and will in the end render this part of the county far more important in an agricultural point of view than it is now.

The buildings on a farm were formerly very extensive, and occasioned a great expense to the proprietors in continual repairs. Since the introduction of the practice of stacking corn out of doors, which is so much better and more economical than laying it up in barns, and especially the introduction of threshing-machines, the buildings are now much contracted, and a less burden to the proprietor, while the rents are improved and better paid. Sheep are still a principal object of the Wiltshire farmer; but his attention is not confined to them, and he makes them subservient to a greater production of corn.

By the old system the sheep ran on the commons or Downs during summer and autumn, and also on the summer fallows till they were ploughed up for wheat: as soon as the corn was reaped, the flocks had the stubbles and the Downs to run on, till winter forced the owners to give them hay, when the farmer found his own fold and hay, the common shepherd still feeding and folding the whole; but latterly each farmer had his own shepherd and folded on his own land. When the ewes are near yeaning, the owner takes them home to the enclosed meadows, and by the time all the lambs are dropped the water-meadows are ready to receive them. As there is seldom sufficient food in winter for the whole flock, a portion is necessarily sold off in autumn to supply other counties, where they have more winter forage, but no commons or downs for summer pasture. Since the introduction of turnips a great change has taken place in the system; many of the wethers and barren ewes are fatted at home, and the only portion sold off are the lambs and teggs, which have been bred for this purpose, without diminishing the breeding flock.

Farms were formerly much smaller than they are at present, but it has been found that the expense of men and horses on a small farm is much greater in proportion than on a larger. It is most advantageous to the farmer when he has the largest flock which one shepherd can manage. If he has more sheep, he must have two such flocks. As much arable land as will fully occupy six horses is as little as can be profitably farmed: more than this requires great activity in the farmer, or the help of a trustworthy foreman to each department—a thing not always to be met with. The management of the arable land was such as the condition of common fields necessarily imposed:—two crops and a fallow, varied occasionally by sowing grass-seeds, which could only be done by a general consent to waive the right of common pasture after hay-making. Since the enclosures the system is improved; turnips are raised in considerable quantities, their use for winter-feed having been soon found out. Clover, sainfoin, and other artificial grasses come into the rotation, and the only fault in the different systems is that which is yet too often met with, of two white straw crops following one another; the only palliation of this is the abundant folding of sheep on the land, which keeps it in heart and prevents its exhaustion.

The Wiltshire ploughs are mostly without wheels or with only one wheel; the former are used on rough heavy soils, and the latter on stubbles and clover leys. In the flinty soils a plough with two wheels is generally used, as being steadier: the furrows being necessarily shallow, the swing-plough would be too easily thrown out of the ground. The heavy white lands require three horses at least to a plough, but the light chalky lands can be easily ploughed with two; and, with good ploughmen, lighter ploughs might be used, such as the improved Berkshire and Suffolk ploughs. The carts and waggons are too heavy. A light single-horse cart is far preferable, and will no doubt be generally adopted when its economy in horse-labour is appreciated. The light thin soils on the Downs, when cultivated, require much skill to make them productive. Formerly they were much worked and pulverized in summer, by which the texture was too much loosened, and weeds were greatly increased. The wheat looked well in spring; but the earth was blown away from the roots in high winds and dry weather, and abundant crops of poppies took the place of the thin and withered corn. Lately the farmers have adopted a better plan; they try to give firmness to the soil by pressure and folding, before sowing, and the crops are much improved.

The common practice of *raftering* the land, as it is called, that is, ploughing a furrow and laying the furrow-slice on the solid land, and then opening another furrow 18 inches from the first, so as to produce another similar ridge, leaving the surface in alternate open furrows and double ridges, has the effect of killing the grass and exposing half the roots to the air, the other half not being stirred. When this is done across the stitches, at right angles, or diagonally, which is better, one harrowing down and ploughing prepare the land for wheat-sowing; and the crops justify the practice, but it is faulty in that it soon fills the land with weeds. One good ploughing and pressing with iron cylinders after a clean layer is a far better preparation. A heavy drag or a nine-share plough is very commonly used as a substitute for ploughing. It stirs and cleans the land at the same time, raising the root-weeds to the surface, to be gathered and burned.

In the sandy soils the seed is generally deposited by the drilling-machine; but where flints abound this implement is not so applicable, and the broad-cast sowing is continued.

The most common rotation now adopted on the heavy white lands, where turnips will not grow, is that of fallow, wheat, beans, oats, clover; or, which is better, fallow, wheat or barley, clover mown, ditto fed, wheat, beans or oats. The second year of the clover it is broken up early in summer and well pulverized, and the sheep are folded on it at night; the wheat is generally good after it. Half the barley or wheat stubble is now generally sown with peas, beans, or vetches, and the other half with clover; the land is kept clean by weeding and hoeing the crops, and the clover is more certain from not recurring so often.

On the sands the Norfolk rotation of turnips, barley, clover, wheat, is commonly adopted, with the variation of a fallow between the clover and wheat, when the land is close folded and thus consolidated. Some good farmers have peas or tares fed off early on half the barley land, to prevent the too frequent recurrence of clover. In the Pewsey vale the sandy loam is so nearly allied to clay as to be cropped like heavy land, and the crops here are more certain and abundant. The Down land is cropped in various manners, turnips and barley or oats being the principal crops; on the deeper red soils wheat is introduced every fourth or fifth year. Rape and rye-grass are sometimes sown together after wheat, to be fed off in spring, and the grass is continued a year or two more to recruit the land. The flocks of sheep which are kept everywhere give the principal supply of manure by the fold; as fewer horned cattle are kept in the yards. When the ewes and lambs feed in the water-meadows, the folding is found to be far more effective than at any other time. This is probably from the abundance of urine produced by the fresh succulent grass.

Potatoes are raised in considerable quantities on the rich sands, which are peculiarly adapted to this crop; and it has been a common observation, that a bad year for wheat is generally a good one for potatoes, which increases the value of this excellent root.

We have alluded to the water-meadows, which in this part of the county are extremely well managed. There are two kinds of water-meadows, those irrigated by catch-work and those which are flooded. [IRRIGATION.] The flooded meadows are those which lie along the course of the rivers or rivulets, and are flat and level naturally, or rendered so by art. The water is let on by sluices and channels from the upper part of the stream, and kept in by banks, if necessary, and let off again into the lower part of the stream, or on lower meadows, by similar sluices and channels. This method requires a greater supply of water and more expensive works. The expense is often from 10*l.* to 20*l.* per acre; but the return is so ample, that this is a capital extremely well laid out. It is computed that there are above 20,000 acres of excellent water-meadows in this district.

As soon as the after-grass is eaten bare in autumn, the water is let on; all the grips and channels which may have been damaged by the treading of the cattle being first carefully dug out and repaired. The best time for this operation is soon after Michaelmas, when the rains bring down fine earth from the hills around. The water generally covers the meadows for a fortnight or three weeks, to "give them a good soaking at first." This makes the surface close, and increases the roots of the grasses. It is then let off till the surface is quite dry again. If any scum appears on the water during the flooding, it is immediately let off, or it would do harm. When the growth of the grass seems to flag, the water is let on again for a few days only. During hard frost it is useful to have all the meadows covered with water, which prevents the frost touching the roots: as spring advances the floodings must be much shorter, till the grass attains the proper size and bulk. Where there is not sufficient water to flood a meadow, or if it lies on a declivity, the catch-work is the only method applicable, and the letting on and off of the water is regulated on the same principle. The great value of early and abundant grass for ewes and lambs makes these meadows of the greatest consequence to the sheep-farmer.

When they are fed off close, by the end of April or later, the water is let on for a day or two, and then let off. In six weeks after a very heavy crop of hay may be made; another short flooding produces abundant after-feed. This however is generally fed off by horses and cows, as it is thought to rot sheep at that time; but some water-meadows on the Avon never cause rot at any time.

The best water-meadows are on a loose bed of broken flints, with scarcely any earth; which would lead one to think that water alone is sufficient to feed plants; but this water is impregnated with mineral and organic matter in extremely minute division, and to these it probably owes its extreme fertility. There are two small water-meadows at Orchiston, six miles from Amesbury, which are usually called the "long grass meadows." They contain together only 2½ acres; but the crop of hay is sometimes so enormous, that the *tithe* of it was once sold for five guineas. It is found, on examination of the grasses, that the *Agrestis Stolonifera* is by far the most abundant, in fact almost excluding all other grasses. This is the *Fiorin grass*, once so strongly recommended by Dr. Richardson as to obtain universal notice amongst agriculturists; but, like other plants overrated by those who desire to introduce them, its celebrity had a short run. As the rivulet which supplies the water to these meadows is subject to great variations in different seasons, and sometimes is low in winter, it happens then that very little hay can be cut in summer: but this is not often the case.

As the cows in this district are not such objects of attention as the sheep, the breeds are very various, and few of them of superior quality. The chief dairies are on the borders of Dorsetshire, whence comes the butter used in the towns, North Wiltshire producing little butter, except whey-butter—its chief produce being cheese.

The Wiltshire sheep are a variety of the South Down, but not in general so pure. The original breed was horned, but this has been almost entirely superseded by the polled breed, which produces a finer wool, if not so large a carcass. Of late the size has been an object to the breeder, since fine wool has much diminished in value. An attempt was formerly made to introduce the Merino breed, and crosses between it and the South Down; but it did not answer: the sheep were too delicate for the climate and feed, and the superior quality of their wool did not make up for the inferiority of the carcasses. There is probably at this moment not a remnant of Merino blood in any flock in Wiltshire.

The great object in keeping a flock of sheep formerly was to fold them, and for this purpose they must be strong and active; but now the early fatting is the principal object, and a different breed answers this purpose best. The South Down breed was introduced into Wiltshire in 1789, by Mr. Mighell of Kennett, and since that time has almost entirely superseded the old Wiltshire breed. Crosses with other breeds, such as the Leicester and Cotswold, are now very common; and since the carcass has become the chief object, these half-breds, as they are called, are thought by some to be most profitable. Their wool is not so fine, but longer, and the fleeces heavier.

The pigs are much the same as in other counties; the Chinese and Neapolitan breeds having by their crosses improved the original breeds and altered all their qualities, they are reduced in size and bone, and fatten both earlier and in less time: all these things have opened the eyes of the most prejudiced. It is remarkable that, while the advantage of a smaller size has been so readily recognised in the pig, many breeders still aim at great size in the horse and ox. Experience will perhaps convince them, in the end, that they are wrong, and that, generally speaking, a small animal of perfect symmetry is more profitable than a large one.

North Wiltshire Agriculture. — The north-western district of Wiltshire differs greatly from the southern district. The subsoil in this part of the county, instead of being chalk, consists chiefly of flat broken stone, called provincially corngrate. It is the same as that of the Cotswold Hills in Gloucestershire. These stones serve for building when they are of sufficient thickness, and the thinner layers to cover houses, instead of slate. The top soil is a reddish calcareous loam mixed with irregular flat stones, and commonly called stone-brash. In some places a stratum of clay is interposed between the rock and the top soil, which may easily be known by the oaks which thrive there, whilst on the other parts the elm thrives best. Where the top soil is thin, it is poorer, and is chiefly cultivated as arable land; where it is deep and rich, there are some of the finest pastures in England, such as those about Chippenham, and thence southward to Melksham and Trowbridge, where the largest oxen may be fatted.

There is a very fertile vein of gravel, or rather of small shelly-sand with pebbles, covered with a good depth of rich mould, which runs in a broken line from Melksham through Chippenham to Cricklade, but extends wider from Tytherton through Christian Malford and Dantzey to Somerford. All this vein is very rich land, especially near Dantzey. The porous subsoil keeps the soil dry and warm better than any artificial draining could do. A less fertile vein of sand runs from Redburn by Seagry, Draycott, and Sutton Benger to Langley Burnell by Chippenham, and another begins at the opposite corresponding hill at Charlcot, and runs through Bremhill to Branham. The greatest part of the residue of the soil of this district lies on a hard close rock of a rough irregular kind of bastard limestone, fit only for mending the roads with: the soil above this rock is mostly retentive of moisture, and consequently cold. Bradon Forest consists of a poor iron-clay fit only for wood, and notoriously ungrateful to the cultivator.

This district is essentially a dairy country, and probably so from time immemorial. The buildings are well suited to this purpose, and placed conveniently with respect to the surrounding fields. The cheese-lofts are often on a very extensive scale; and all the buildings are kept in a neat and substantial order. Leases are common for fourteen or twenty-one years, and the tenant is prevented from selling hay or straw, which secures this keeping sufficient stock for manure. The implements are similar to those used in the south-eastern district. The common fields have been mostly enclosed by act of parliament, to the great advantage of the husbandry. Some of the best land has been laid down in grass, and a better system of cropping has been generally introduced, and a cleaner tillage.

The most common rotation in the beginning of this century was that of wheat, oats, turnips, barley, clover mown, then fed, and summer-fallowed for wheat. This was not a bad course, but improvements have been introduced according as the soil was heavier or lighter. Folding sheep on wet cold clays is never profitable, and feeding oxen on oil-cakes and hay has only been introduced of late years, and is by no means generally adopted as a system. Barley does not come to such perfection in the heavier soils, which are better adapted to beans and vetches as a preparation for wheat, instead of a too frequent recurrence of clover. The turnips after wheat and oats, with only the sheep-fold to recruit the land, are never so good as with good yard-muck; and the feeding of sheep on the turnips does not sufficiently enrich it when the crop is light. Most of the cold clays require draining, an improvement of which the effects are so striking that it must soon become very general on such soils.

The grass land forms the greater portion of North Wiltshire, and the cheese made there is justly celebrated. It is mostly bought up by factors for the supply of London and other large towns. The dairy is managed in the best manner, and so much depends on this, that with care nearly as good cheese may be made from inferior pastures as from the best. There is an opinion that poor land gives the best cheese, and this notion prevails in Cheshire: but there are many reasons for thinking that this opinion has no foundation. The land may be poor for corn, and yet produce very sweet herbage, as in the case of the Downs; but a rich milk equally well managed will produce a richer cheese. No one will assert that the Stilton cheeses made in Leicestershire, on the richest pastures, or that the Gruyère or Parmesan cheeses, are not of superior quality to any cheese made on poor land.

Formerly the cows were fed with hay in winter in the pastures: but so much damage was done to the land by the treading of heavy animals in wet weather, that many dairymen now keep their cows in the stalls from November to April, as they do in Holland. They find the advantage of this practice both to the cows and the pastures; and this also gives them manure for the arable land, as well as the grass land, which is more improved by manuring with a rich compost than by the irregular droppings of the dung from the cows in the pastures. The manuring of grass land is generally done immediately after hay-making. This improved system, and that of feeding and mowing the grass land alternately, have done much good to the pastures, and kept them freer from docks, thistles, and other weeds.

Much of the heavy wet soils has been improved by under-draining, but a great deal remains to be done. The stone in the substratum is well adapted to fill drains with, and if these are only made sufficiently near to each other, the nature of the soil will soon be altered for the better, where it is too wet and cold.

Considering the extent and perfection of the water-meadows in the southern district, it is surprising that there are so few in the northern. This must be ascribed to the difference in the systems pursued on sheep-farms and dairy-farms. There is not the same necessity for a rich food early in spring; and upland hay is plentiful and preferred by many to lowland meadow hay: yet the advantage of water-meadows for cows, as well as sheep, should have drawn more attention to their formation.

The breed of milch-cows is an object of greater attention in this district than in the southern. The long-horned breed was formerly in high repute, as the old cows fatted well and produced good prices from their weight. Each cow of the large breed will give from 3 to 4½ cwt. of cheese in a season, if she calves in proper time. But if more cows of a smaller breed can be fed on the same land, and thus every acre produce more cheese, whatever each cow may give, the smaller cow is evidently the most profitable: besides, smaller animals require less food, and will thrive where the larger would fall off. It will probably be found, in the end, that good breeds of small cows pay best: such are the Ayrshire cows and the small Suffolk polled breed. The North Devon are sometimes excellent milkers, and they certainly are the handsomest breed. A great many cows are fatted in the dairies, when they are dry or have missed calving.

There are very few market-gardens or orchards in this district, and no cider is made. Vegetables are only raised for sale near the towns; every farm having as much garden as the family requires, and no more. The woods have diminished greatly all over the county, which was once very well wooded; and the fuel being dear from the distance from coal-mines, the decay of the woods begins to be felt. If plantations were judiciously made, there is no doubt but they would ultimately pay well. Much of the land is peculiarly suited to the growth of timber and underwood.

The sheep in this district are much the same as in the southern portion of the county, and although there are not so extensive sheep-pastures, there is usually a flock attached to every arable farm, and folding is one of the chief modes of manuring the fields. Cattle fatted in yards would probably produce manure of a better quality for turnips, and would be more economically fatted than sheep, for which there is not always sufficient feed at all times of the year for want of water-meadows.

Many porkers are fatted in the dairies on the whey, after it has been skimmed and whey-butter made, and the breed of pigs has been much improved of late by judicious crossing with small-boned breeds which fatten earlier and in less time. There is nothing peculiar in the breed of horses; those used on the farms are mostly imported young from other counties.

WOAD (*Isatis tinctoria*) is a plant which was once cultivated in Britain to a great extent for the blue dye extracted from it. It has been greatly superseded by indigo, which gives a stronger and finer blue; but on some soils it might be still cultivated to great advantage, especially as it is said to improve the quality and colour of indigo when mixed with it in a certain proportion.

The woad is a plant of the natural order of the Cruciferæ, classed by Linnæus in the Tetradynamia siliculosa. It has a strong tap-root, which lasts two years. The height of the plant when in perfection is from three to four feet. It throws out many branches from the upper part of the stem. The leaves are alternate and smooth, the lower on foot-stalks, large and spear-shaped, the upper embracing the stem, and arrow-shaped. The flowers are yellow, in panicles at the extremity of the branches. The fruit is a heart-shaped pod, with two valves containing one seed only. It grows well on the borders of the Baltic, and is very hardy.

It is still cultivated to a considerable extent in the south of France and Flanders. It requires a good substantial soil of considerable depth and fertility; for the larger and more numerous the leaves are, the more profit is derived from the plant. A wet clay soil is not at all suited to its growth, nor a loose sandy one. The first would prevent its roots striking sufficiently deep in search of nourishment, and the latter would be too loose, and not keep up a sufficient degree of moisture.

When it was largely cultivated in England, old pastures ploughed up afforded the best soil for the woad to grow in. These were often taken at a very high rent for two years by men who made it their business to cultivate the woad and prepare the colour, and who found it a profitable speculation. In consequence of this practice some proprietors prohibited their tenants from cultivating woad, a short-sighted policy equally injurious to both. To have good woad the land should be naturally very rich, or much manure should be intimately mixed with it some time before; nothing but completely decomposed dung should be used, or compost made on purpose a long time before.

The land, having been prepared by repeated ploughings and perfectly clean, is laid into narrow beds with deep intervals. On these beds the seed is sown in February or very early in March. It is sometimes sown broadcast, and the plants thinned out, but sowing it in drills, two rows on a four-feet bed, is much the best practice. The drills are one foot from the edge, with two feet clear between them; some make five-feet beds, and there is an interval of thirty inches between the rows, which allows of better cleaning, and gives the plants more room to spread. When the plants are come up in the rows, they must be thinned out by hand, leaving the strongest about two feet apart; the leaves will soon fill up the intervals. They begin to ripen in June. They are fit to gather when they begin to droop and become yellowish. This should be done in very dry weather, and after the dew is off. The leaves of the woad are either twisted off close to the stems or cut down with a sickle. Great care must be taken that no dirt or earth adheres to them. Some recommend taking off the lower leaves first, when they appear ripe by drooping and turning yellow, and letting the upper leaves remain till they show the same appearance; then nothing but ripe leaves will be gathered. This stripping may be repeated two or three times as the leaves grow again. The plants destined for seed are only stripped once or twice, for fear of weakening them. It might probably be advantageous not to strip them at all, but to leave the whole strength for the formation of the seed, which will be larger, and produce finer plants the next year.

The first gathering of the leaves is the best; they should therefore be kept separate to obtain the best dye. As soon as the leaves are gathered, the beds should be well and deeply hoed or dug, to give a fresh impulse to the roots.

The leaves are naturally full of sap, and soon begin to decompose if laid in a heap. They should therefore be partially dried, and immediately carried to the mill to be manufactured.

There is a variety of this plant cultivated in Flanders and about Valenciennes, which has seeds of a violet colour, and the leaves very smooth; it is larger than the other, and gives a better dye. It is that which is cultivated near Avignon, whence the best woad dye is procured. The leaves are ground in a mill, like an oil-mill, into a paste, which when quite uniform and smooth is laid in heaps under a shed, and pressed with the hands or feet into a mass: each addition is carefully joined to the preceding, so that the whole crop forms a long heap. A fermentation is soon established, by which the blue dye is separated. A black crust is formed all over the heap, which keeps in the gases produced. If any part of this crust is cracked, it must be immediately stopped up with some of the paste. It takes a fortnight to complete the operation. When the disengagement of phosphorated ammoniacal gas ceases, which is soon perceived by the smell, the heap is broken up, the crust is mixed with the inside, and small portions like bricks, of about one pound weight, are made up with the hands by pressure in a mould, which when dry are fit for sale. As great attention is required both in the growing and preparing of the woad, it is best done by those who make a trade of it, and have the necessary experience. When the crop succeeds, the profit is very considerable; but, like all other crops, it is liable to many accidents.

Woad is often shamefully adulterated by mixing earth and other impurities with it; but those who have recourse to such deceit always suffer in the end by the loss of character and the consequent decrease of their trade and profits. In Germany the process of preparing the woad is somewhat different, as appears by a publication on the subject, by Mr. Green. The leaves are first washed, and then put into a tub three-quarters full of water, and kept under water by blocks of wood laid on them. The fermentation soon begins, and is shown by a blue scum on the water. When it has gone on to a certain point, the water is drawn off below, and it comes away of a deep green. It is strained through a cloth, the remaining leaves are washed with fresh water, and this is added to the first. Lime-water is now added, in the proportions of two or three pounds for every ten pounds of leaves used, and the mixture is well shaken for some time; the dye is deposited in the form of a powder, as starch is; the water is decanted off, and the thick part at the bottom is filtered through very fine cloths; the powder which remains is washed repeatedly, till the water comes off without being discoloured. The residue is cut into squares and set to dry. If there is too much water added the dye is inferior; and if not enough, there is less of it. The exact quantity can only be decided by practice and experience.

The seed will vegetate when two years old, but cannot be depended on after that.

Woad is also occasionally sown as food for cattle; and as everything, old and new, has been brought forward by the late renewed zeal for agriculture, it has been recommended for this purpose under its French name of "Pastel." Its vigorous growth and hardy nature have recommended it; but it will only grow in very rich soils. There are many other plants as vigorous and hardy, which will thrive well in inferior soils, and therefore are to be preferred. But for its dye this plant is well worthy of the attention of those who have good rich and deep soils.

WOODS. There are in England many old natural woods remaining, besides the royal forests, although the great demand for timber during the last war has greatly thinned them of their finest trees. When woods were abundant, and covered a great portion of the land, little attention was paid to the increase or preservation of the trees: kings and lords of manors readily granted to their tenants rights of commonage, with the privilege of lopping the branches, always supposing them to be useless dead wood. The consequence of this is still to be seen in all old forests, especially the royal forests, which never were enclosed or protected. The fine old trees, whose age can scarcely be guessed at, which are very picturesque objects and a fit study for the landscape-painter, have all evidently been lopped, at some time or other, for the sake of the wood for fuel, and for want of care have probably never been in such a state as would afford fine timber for ship-building. Windsor Forest, which has only been inclosed since 1813, affords many specimens of noble trunks now hollowed out by time and the admission of water from above, which might probably still be sound and solid had they been duly protected, and only those branches carefully cut out which were dead and showed decay. The dates of the inclosures of different parts of Windsor Great Park can be readily discovered by observing the form of the oldest trees. In many extensive woods on private estates the want of care may be readily seen at the first inspection. Oak-woods are chiefly found in stiff clay soils, where the water is apt to accumulate, by which the roots are injured, and the trees decay before they have attained their full growth. The water should be carefully let off by open drains and ditches, which should be regularly examined and cleared out every year before winter. The surface being thus kept dry, the timber, as well as the underwood, will grow much more rapidly, and the increased value of the wood will amply repay the outlay. Cattle should be carefully excluded from all woods; they destroy the young shoots by cropping them, and do much damage to the underwood. At the time when acorns and beech-mast are plentiful, pigs may be turned in without danger; they will turn up the ground in search of their food, and thus bury beech-mast and acorns, which may vegetate, and grow in time into fine trees; for it is well known that an oak raised from an acorn is always hardier and better rooted than one which is raised in a nursery and transplanted in the woods; and the same may be said of beech raised from the seed.

The sweet chesnut is one of the most useful trees in a wood, provided it has room to grow. Its timber, when of a certain age, is as durable as oak, and the shoots which spring up from the old trunks cut down give the most useful and profitable coppice-wood. When it is recollected that a coppice may be cut advantageously every tenth year, if a calculation be made of the value of growing timber after many years, it will be found that the underwood, properly managed, pays fully as well as the timber. It is usual to cut down such trees as begin to show decay at top, when the coppice is cut; but it is better to anticipate this decay, and cut them when they have ceased to increase from year to year as much as the interest of the money they would sell for amounts to. For example: Suppose that an oak standing measures fifty cubic feet, and with top, lop, and bark, and may be worth 10*l.* If it does not increase above two cubic feet in a year, it will not be profitable to let it stand: but if, by cutting down others which interfere with the spread of its branches, its growth can be promoted, it may probably increase so much as to pay a good interest on its value; in which case it would be a loss to cut it. There is a period when the increase of the wood in a tree is a maximum, and this depends on soil and situation. The head and branches contribute much to the growth of the trunk; and unless they have room to spread, the increase derived from the action of the leaves must be checked. On this depends the practice of gradually thinning out young woods as the branches spread, the object being to let in as much air as is necessary, without leaving too great a space between the head of one tree and its neighbours. As soon as the branches begin to approach towards those of another tree, room must be made, by cutting out those trees which appear inferior in shape or in health. In the management of young plantations [PLANTING], it is a question whether it is more profitable to cut down trees at the age of thirty or forty years and replace them with young plants, or to let them arrive at their full size, which, for oaks, will take 150 or 200 years. The calculation is made on the annual increase of the wood, which is said to be greatest when the tree is about thirty years old. It has been often supposed that the slower a tree grows the stronger the wood will be; but this appears to be a mistake. Some wood taken from a very rapidly-growing oak, and some from one which, having been headed down as a pollard, had grown slowly, were tried by the action of a very powerful hydraulic press, and the wood of the quicker-growing tree was found to resist the pressure much longer before it was broken or crushed.

Although it is generally on soils unfit for cultivation that plantations of wood are made, yet there are proofs that, on a deep rich soil worth 2*l.* an acre as arable land, a plantation of oaks, well managed for fifty or sixty years, will pay a better rent than if it had been cultivated as a farm. On such land it is usual to plant oaks in the hedge-rows, where the trees, having room both for their branches and their roots, thrive well at the expense of the farmer. Most old farms consist of small inclosures surrounded with trees, chiefly oak, ash, and elm, according to the soil; and the landlord, having the benefit of their growth, only cuts them when fit for sale. The tenant is scarcely aware of the annual loss he suffers from the shade of the trees, as well as the exhaustion of his manure by the roots. If the inclosures are of the extent of twenty acres or more, a few trees here and there in the banks will not do much harm; but it would be far more advantageous to all parties if the woods and plantations were entirely separated from the arable land. A few single trees here and there in old pastures are both ornamental and useful as shelter for the cattle; but they should be extirpated in all arable fields. Clumps and woods may be made picturesque in the scenery, whereas a country consisting of small inclosures surrounded with trees only looks like an immense wood when seen from a small eminence.

Pine-trees of full size have been transplanted to form shelter and ornament to parks and pleasure-grounds. Sir Joseph Banks made some experiments in his grounds near Brentford, by cutting off the heads of old elm-trees and transplanting the trunks, by way of keeping up a proportion between the head and the roots, in the expectation of their growing out, but it failed entirely; and even if the experiment had succeeded, the trees would have had the appearance of pollards, and been very far from ornamental. Sir James Stewart Monteith, in Scotland, succeeded better by retaining the head, and saving, as much as possible, all the fibres of the roots; for this purpose the earth was carefully taken from about the roots, beginning at a considerable distance from the stem: the tap-roots, if any, were necessarily cut off, but all the horizontal roots were saved. The tree was taken up on a strong carriage, and placed upright on the spot prepared for its reception: this had been well dug and pulverized, and the surface-soil or turf laid aside. If the soil was not naturally rich, some manure was dug into it. If this was done some months before, and had the benefit of a winter's fallow, the success was more certain. The tree was now placed upright, taking care that it should have the same position with respect to the cardinal points as it had originally, so that what was exposed to the north before should be so still. The roots were then spread on the prepared ground, and occasionally pegged down with hooked sticks driven into the ground; fine earth was then spread over them to the depth of four or five inches or more, and well rolled or trodden down on the roots. A watering, especially with diluted urine or drainings from dunghills, served to settle the earth about the roots; and a few strong ropes tied high up the stem of the tree, and fixed to strong posts in the ground at some distance from the trunk, so as to prevent the effect of strong winds, finished the operation of transplanting. The best time is early in spring, when the leaves are beginning to expand and when showers are frequent. Thus large forest-trees fifty or sixty years old have been transplanted without any part of their branches dying off; and a park and plantation have been formed in one season, where not a tree was to be seen before. This may be considered as a valuable discovery in a country where so many new parks and pleasure-grounds are continually formed.

Wood is too valuable in Britain to be used for fuel, except in very distant and woody districts. Coals have everywhere superseded it; but wherever woods are cut down, and especially where the roots are grubbed up, they give an excellent and economical fuel for the poor, or to use in the lime and brick kilns. Where old hedge-rows are cleared in the progress of agriculture, it is a common practice to give the stumps and roots found in old banks to the poor, for the trouble of grubbing them up and levelling the ground. This work is generally done in winter; and the wood is stacked into cords six feet long, three feet wide, and three feet high, and sold, in Berkshire, from 5*s.* to 7*s.* a cord: where coals are 30*s.* or more a ton, this is a great resource.

In France and other countries where

they use chiefly wood for fuel, the trees which are preferred are beech-trees, which are allowed to grow very close in the woods, so as to draw each other up and form long thin stems. They are cut down when about thirty or forty years old, and then do not average a foot in diameter; they are sawn in lengths of a yard, and thus sold, the purchaser generally having them sawn into shorter lengths and split for use. In Paris the trade in wood is one of the most extensive, and employs many hands; and fuel is becoming scarcer and dearer every year; so that unless coal-mines shall be worked to a greater extent in France, there will soon be so great a scarcity of wood, both for fuel and building, as to cause serious inconvenience, and cause much land now in cultivation to be planted. In England chiefly the timber is raised for building, and with proper attention to the old woods, and by judicious plantations of new, timber may be yet raised to a much greater amount than it is, and without encroaching on the land devoted to the crops necessary for the sustenance of man.

WORCESTERSHIRE AGRICULTURE.—The climate of Worcestershire, especially in the middle, south, and west of the county, is remarkably mild and healthy, and the fruits of the earth are brought to early maturity. The vales of Severn and Avon are but little raised above the level of the sea; and it has been observed that an elevation of sixty yards makes a difference in climate equal to a degree of latitude towards the north, soil and other circumstances remaining the same. The higher parts of the county, between Bromsgrove and Birmingham, have consequently a later harvest. The higher hills, such as the Malvern Hills, are proportionally colder and later. They tend to shelter the vales between them from the cold winds, and add to the mildness of the climate there.

The Vale of Severn, which extends about 30 miles in length from north to south, contains some extremely rich alluvial soils, which from their situation are admirably adapted for rich pastures. The banks of the Avon also, which falls into the Severn near Tewkesbury, are rich, and consist mostly of meadows and pastures.

The Teme winds through the county for about 30 miles. Along its banks are many hop-gardens and orchards, a sure proof of a good deep soil; and the lower parts form rich meadows. Several lesser streams run in their own valleys, the soil along their banks being generally good, except in a few instances in which bogs have been formed, by the stagnation of the waters, with their accompanying peat. Except where the higher hills rise in peaks, the surface is in general gently undulating. One half of the county consists of rich loams and clay soils. The sands which are met with near Kidderminster are some of them productive, and others very poor, as about Mitten and part of Wolverley. The mixed springy gravels and gravelly loams to the north of Bromsgrove are less fertile; and there the harvest is later and more uncertain. Upon the whole, few counties in England contain so much good land, and, as a consequence, fewer wastes. Viewed from the hills, the valleys give the idea of very successful cultivation. The soils of this county may be arranged, without pretending to great accuracy, as follows:—

	Acres.
Light land, sand, sandy loam, gravel, and gravelly loam	120,000
Mixed friable loams adapted to general culture, fit for turnips, hops, fruit, &c. .	120,000
Strong clay loams, which, where they are dry, are adapted to hops, fruit, wheat, and beans, but too strong for turnips . . .	120,000
Natural meadows along the course of the rivers . .	50,000
Upland pastures, parks, and plantations	50,000
Woodlands, roads, villages, towns, and water . . .	20,000
Wastes and commons . . .	20,000
	500,000

The farm-houses in Worcestershire are generally substantially built, but they are often inconveniently situated with respect to the land, owing to their old divisions in common fields, which are now mostly inclosed. Some modern erections are an exception; but, in general, the offices and buildings for the convenience of the farmer are not of the best construction.

The farms are most of them small, which indicates antient cultivation; but they are generally enlarging, by uniting several of them under one tenant. Leases are not generally granted by the proprietors or demanded by the tenants, except where improvements are intended, in which case they are usually for twenty-one years. Those who grant new leases, when it has been their custom to have only tenants at will, are apt to load them with conditions, which at best are useless, and only impede improvements. All that is required is some security against over-cropping at the end of the lease, and against wilful damage done to the land. This may be easily secured by submitting to a survey, and engaging to pay damages on deterioration of the land; preventing the sale of hay and straw, except on condition of purchasing a proportional quantity of dung, bones, lime, &c. to be laid on the land, and all the dung made in the last year to be left and paid for at a valuation by the succeeding tenant, which will secure a proper quantity. The commutation of the tithes for a rent-charge greatly tends to encourage improvements, the whole profit of which is secured to the improver without participation. It is a very great relief to the cultivators of hops.

The ploughs in common use in Worcestershire have two wheels attached to the beam, as in the Rutland plough. They are usually drawn by three horses, and easily managed in soils which are not stony. In the vale of Evesham the old heavy swing-ploughs were formerly used, but have given way gradually to lighter ploughs with one or two wheels. In the light sands a double plough making two furrows at once has long been in use, but if it is drawn by four horses, it occasions no saving of labour. It is only useful where one man can plough with two or at most three horses abreast, which are guided by reins. Thus a man and at least one horse are saved, and good work is done.

The other agricultural implements in use were formerly only carts, waggons, rollers, and harrows. All the new implements have been only lately recommended; and their general introduction goes on slowly, many disappointments having arisen, owing to a want of sufficient skill in the labourers to use them properly.

Fallowing the heavy lands is still the general practice, in spite of all that has been said and written against this unnecessary waste of labour, without any return, as some pretend: but the defenders of occasional fallows have experience on their side, and will not altogether abandon a practice which has hitherto been thought economical, as well as essential. On light soils roots and hoed crops may be a proper substitute for a clean fallow; but peas and beans or vetches, which alone can be introduced as fallow crops on heavy land, will not always prevent the accumulation of root weeds, which an occasional clean and well-stirred fallow readily destroys. But to tie down a tenant to have a certain portion of the farm fallowed every year is an unnecessary restriction, for which a prudent tenant will demand some allowance in the rent.

The rotations vary according to the nature of the land. On the richest soils the following is very profitable, but requires more manure than is made by the crops, viz.:—turnips, barley, clover, potatoes, wheat. The potatoes, if sold, return nothing in the shape of manure compared to what they require; but they sell well wherever the population is large, as near manufacturing towns; and there manure can always be obtained for back carriage. Wheat is not so good after potatoes as after clover; but with due attention to the tillage, and the use of the land-presser where the soil is too loose, a good crop of wheat is often obtained after potatoes: and the two valuable crops succeeding each other bring a considerable profit to the farmer. By making potatoes a part of the fallow crop, barley will come after it, which is often better; but this diminishes the breadth of turnips sown, and the consequent manure from the cattle and the sheep. In this case the rotation will be turnips and potatoes, barley, clover and tares, wheat. In the next course the potatoes will be where the turnips were before, and vice versâ. The clover will be sown in the part which had tares, and thus potatoes, tares, and clover only recur every eighth year.

Where the soil is heavy and not rich, the most common course is fallow, wheat, beans, barley, clover, and grass seeds to lie three or four years. When the land is broken up, it is sown with oats, and then fallowed, to begin the course again. This is a good system, but not so much adopted as it should be. The clover is often broken up after one year, and succeeded by wheat, which, in this case, will be but a poor crop. It would be better to lay down the land with clover and grass-seeds sooner after the fallow, and to take the wheat and bean crops when it had been recruited by feeding with sheep. The crops might be the same, but arranged in a better order. Where the land is of a proper consistence to bear good beans, this crop may be drilled or dibbled on the grass lands when first broken up, and be succeeded by wheat, if there be no couch-grass, and if the beans have been carefully hoed.

Rye is cultivated chiefly to cut green for cattle, or to feed early ewes and lambs. It was formerly an important crop, when rye-bread was the principal food of the labourer: but now he will have nothing but pure wheaten bread; so that rye is only cultivated on very loose sandy soils, where wheat will not succeed so well, and it is chiefly sold as seed to produce early green fodder. The Siberian winter barley is as early, and, in general, a heavier crop; but it is not so much sown as rye.

The average produce of wheat in Worcestershire is higher than in many other counties, which proves a superior average soil. The old Worcester bushel contained nine gallons, and the bushel of wheat weighed 70 lbs. This produced 56 lbs. of flour, and made 70 lbs. of bread.

The wheat is reaped by the sickle, and a long stubble is usually left, which is afterwards mown or raked up for litter. The mowing of wheat is not yet very common, but when the labourers shall have learnt the use of the cradle-scythe, it will no doubt be more generally adopted. There are many advantages in mowing wheat. None of the straw is wasted; the harvest is sooner finished; and the seeds of weeds are more easily destroyed, by sifting them out of the corn and straw, while they may be steamed, and increase the food of pigs and poultry. [Wheat.] The practice of fallowing during two successive winters, and sowing barley in the second spring, has been adopted by some farmers with great success, sheep having been folded on the land the last winter. Thus the land is made very clean, and manure is saved. The barley thus raised is good in quality; and the grass-seeds come up well after the folding. Oats are not so general a crop, and no more are usually sown than will supply the wants of the farmer's horses. Beans are set or dibbled in by women, who use a line to set them by. They are hoed three times, and, in general, the return is abundant, frequently 40 to 45 bushels per acre from three bushels set. The produce of beans is greater than the wants of the county require.

Vetches are a valuable crop in lands which are too heavy for turnips, either to give them to sheep in a fold or to soil horses with in the stables. If they are sown at regular periods, so as to keep a constant succession of them from May to November, which may easily be done by sowing winter tares once a fortnight from September to November, and spring tares from February till May, in such quantities as the stock may require. Thus not only is there a great saving in fodder —for the horses require no oats if they have good vetches with the pods and half-formed seeds—but much excellent manure is made for the land. Vetches may be looked upon for heavy soils, as turnips are for the lighter. They require less tillage and hoeing, and clean the land by smothering the weeds. The land should always be well manured for them to secure a heavy crop. It is not advisable to wait for a second growth of vetches: as soon as they are cut or fed off, the land should be ploughed; and if no intermediate crop is sown, it can be worked as a fallow for the next crop, which may be wheat, beans, or barley, according to circumstances.

Potatoes are raised in great abundance in this county, and supply the markets of Birmingham and Staffordshire. There are many varieties of early and late potatoes, which have provincial names, but which it would be difficult to describe, as their qualities change in different soils. Turnips used formerly to be sown broadcast, and some farmers still adhere to the practice; but all the best farmers, especially where the farms are large, adopt the system of sowing in drills.

Wolverley sands have long been famous for the growth of carrots and for raising carrot-seed. The ground is trench-ploughed. The seed is mixed with sand to prevent its adhering by its edges, which have small hooked fibres all round. A drill is opened by a machine, and the seed is deposited by hand. A machine that will drill carrot-seed is still a desideratum. The time of sowing is in March. Great attention is paid to hoeing and weeding as soon as the plants appear: for the weeds are very apt to get the start of them. This makes the cultivation expensive, but the return is very great, without much exhausting the soil. They sell readily for two shillings per cwt. on the spot, and a crop of fifteen to twenty tons per acre is not uncommon, that is, from 30*l.* to 40*l.* per acre. A part is used for culinary purposes in the towns, and a part given to horses, who are very fond of them, and thrive well upon them. The orange-carrot of the large varieties is that usually sown. The Belgian white carrot is more productive, but not so saleable in towns. Flax is not cultivated as it should be in the richer soils: this is owing to the prejudices of landlords or their agents, who prohibit its cultivation as exhausting the land: under proper regulations it might be a source of great profit both to the landlord and the tenant; and it may be laid down as a general rule, that what is profitable to the tenant will in the end be advantageous to the landlord, and that the interests of both may be consulted without many prohibitions or restrictions.

Hop-yards occupy some extent, and are attended with great risks, as well as occasionally with very great profits. The commutation of the tithes, as observed before, has been very advantageous to the hop-farmer. The cultivation of this plant is a perfect garden culture, chiefly by the spade. Much manure is used if the land is not naturally very rich. Deep meadow-land trenched up produces the most abundant and certain crops. Composts of rotten dung mixed with sods, and sometimes with woollen rags, are used by the best hop-growers. [Hops.] The average expense of the cultivation, exclusive of the duty, is about 12*l.* per acre. The extent of hop-grounds in the county was about 6000 acres in 1807. In a soil so well suited for orchards as is found in certain parts of Worcestershire, it is surprising that the cultivation of fruit-trees is so far behind other improvements. The old orchards are filled with trees which once were vigorous, but show great symptoms of age and decay: some fresh plantations have been made, but even in these no great attention has been paid to have fruit of the best quality, especially apples for cider. The trees stand too near each other to bear abundantly, and they are seldom sufficiently protected from injury by cattle turned out to feed on the herbage. Formerly fruit-trees were planted in hedge-rows, which only enticed depredations, and did more harm by their shade on the land than their produce was worth. These have been mostly cut down. The deep loams on a subsoil of soft sandstone are the most favourable for orchards. These are found in the western part of the county. The best loam inclines to a marl. The stocks are obtained from the nurseries, where they are raised from crab-trees, and sold from 8*d.* to 1*s.* 6*d.* each, when seven or eight feet high. They are grafted after they have been planted some time. The head is sawn off, and the scions inserted in the manner called *crown-grafting* or *saddle-grafting*. They begin to bear in about five years. In the choice of grafts sufficient attention is not always paid to the age of the tree from which the graft is taken: and thus many disappointments arise from the young trees showing all the symptoms of the diseases of age. It is not recollected that the life of the graft is probably only a continuation of the life of the parent tree; and if this is old and exhausted, the graft will soon show the same defects and diseases. Most of the favourite old sorts, such as the golden pippin and several others, are now nearly extinct, and no grafting can renovate them. The only means of obtaining fine sorts is to sow the seeds, and let the wild tree show fruit: in many hundreds of wild apples one may be found that is good; and this can be perpetuated by grafting for a couple of centuries, and no more: cultivation and judicious pruning will greatly increase the produce. The common method of making cider is by crushing the apples by means of a heavy stone rolling in a stone trough, and moved round by manual labour or by a horse. Pear-orchards are common in Worcestershire.

There is much fine timber growing in the hedge-rows; whether advantageously to the proprietor or farmer may be matter of doubt: elms predominate, and grow to a large size where they have room. There are also some woods and plantations of oaks and ash, the underwood of which forms valuable coppices. In many of the parks and pleasure-grounds which surround the seats of the nobility and gentry are many splendid trees preserved for ornament; and the whole country, when viewed from an eminence, gives the idea of a thickly timbered country, and of great richness.

Draining has been practised for a long period on many of the principal estates, chiefly on Elkington's system, which is excellent for carrying off deep-seated springs; but the modern method of thorough draining was not so well understood. Many of the low grounds on retentive subsoils would be much benefited by this operation, and nowhere would it repay the outlay better. Paring and burning the surface of boggy land, where the grass is coarse and sedgy, is practised with success by some farmers who are not restricted by their landlords. The first crop is potatoes, which always do well in the ashes; the next is wheat or oats; and the land should then be laid down again with the best grass-seeds; a previous dressing with lime will much improve the subsequent pasture.

There are not so many irrigated meadows as one would expect along the banks of so many rivers and smaller streams: this is owing in part to the rights of certain mills erected on every stream, which prevent the free use of the water at all times. Where irrigations have been established, the water has been brought from a considerable distance by canals, which supply several farms on one estate. The water is let on and off under strict regulations, and the effect on the grass in spring is wonderful. There is no doubt that many more water-meadows might be formed without interfering with the mills; and many of the latter are small and insignificant, and do more harm, by obstructing the course of the water, than they afford profit to the owners, who are generally also proprietors of the land around.

There is no peculiar breed of cattle in Worcestershire. They are chiefly obtained from Herefordshire and South Wales. The Holderness breed has been introduced, as it is everywhere else: but few pure cattle are bred in the county; they are all mostly crossed without much judgment. The best and most profitable breeds to stock the rich pasture are the Herefords and Devons, which get into excellent condition by a summer's run, and are then finished in the stalls with hay, turnips, and oil-cake in winter: very fat beasts are sent up to Smithfield and to Birmingham every year from this county.

The sheep are mostly of the Leicester breed, which suit the rich pastures. On the Malvern Hills are some small hardy sheep, without horn, with grey faces and legs, which, when fatted at a proper age, make excellent mutton. The Cotswold, and a cross between them and the Ryeland sheep, are approved of by some: they have good carcasses, and bear large fleeces.

The horses for farm-work are mostly of the strong black breed. Oxen are seldom used on a farm. A little cross of pure blood would greatly improve the pace and courage of farm-horses. They would be lighter and more active, and thus do more work.

As is generally the case in deep rich loamy soils, such as are found in the vale of Evesham, the roads were formerly very badly maintained. In 1792 a club of gentlemen and farmers was established for the especial purpose of attending to the roads, and regular rules and regulations were drawn up. Some of the members being appointed surveyors of the roads, and availing themselves of the powers of the highway act, without any oppressive demand for statute duty, or additional highway rates, but simply by seeing the duty fairly and properly done, made and repaired the roads so that, from being nearly impassable, they soon became excellent; and the most determined grumblers and opposers of all improvement were forced to admit the great advantage of good communications, and the economy of horses in consequence of good roads.

YORKSHIRE AGRICULTURE.—This is one of the most important counties in an agricultural point of view; but from its great extent, and the variety of soils and difference of climates which are found there, it is absolutely necessary to treat of its subdivisions or Ridings separately, and consider them as if they were separate counties. We shall begin with the *North Riding*, which extends southward from that portion of the county of Durham which lies to the north of it along the coast of the North Sea or German Ocean to the river Hartford, which forms its southern boundary, as far as Stamford-bridge, where the road to York is its boundary till it meets the Ouse: it then has the Ainsty of York to the south-west, and the West Riding and Westmoreland to the west. The length of the Riding from east to west is 83 miles, and from north to south 47 miles: it contains about 1,300,000 acres, of which nearly one-third are uncultivated, or at least were so at the Agricultural Survey in 1800. Some part of this has no doubt been brought into cultivation and some planted, but there are still extensive moors and mountains, which are scarcely capable of much improvement.

The soil on the coast is mostly a brownish clay, or a loam incumbent on a clay or on freestone; and in some valleys west of Whitby the soil is a rich deep loam. The soil of Cleveland is mostly a fertile clay or fine red sand, as betwixt Marske and Worsall, and about Lavington and Crawthorn. In the neighbourhood of Kildale there is a good deal of deep rich loam. The surface is diversified with hills, and there are very few level fields. Near the Tees in the valley of York there is generally a rich gravelly loam. On the whole it may be asserted that in all the valleys and on the lower hills the soil is fertile, and mostly fit to bear good crops with proper management. The extensive tract of high hills called the Eastern Moorlands, which occupy a space of about 30 miles by 15, is penetrated by many cultivated valleys more or less fertile. The hills are covered with ling where the freestone does not crop out and present a bare rocky top. The western moorlands have not the same dreary aspect, but are covered with green pastures; and even where it is brown with ling there are sweet grasses interspersed with it, which the cattle and sheep soon find out. The farm-houses are not generally so conveniently situated for the occupation of the land as they might be, but are often crowded in villages at a distance from the fields. Where new buildings have been erected on the inclosures of common lands, they are better situated, and save the farmer much useless expense in the carrying home of his crops and hauling manure to his fields. Large hay-barns were once thought essential, owing to the uncertainty of the weather; but now that the hay is mostly stacked in the meadows, these are no longer necessary; and where they remain they only cause a useless expense in repairs. When a tenant hires a farm, he expects to find the buildings in good repair, and engages to keep them so, which condition is not often strictly adhered to. The cottages for labourers are small and mean, and generally consist of two small rooms on the ground floor, which is often damp, and consequently unhealthy. Nothing is so important to the farmer as that his labourer should be comfortably lodged, and have a certain extent of garden-ground to raise vegetables for his family.

He will not then be tempted to steal the turnips and cabbages on the farm.

The farms in the North Riding of Yorkshire, as in the rest of the county, are of every imaginable size, from 50 to 1000 acres and more. It is generally found that farms from 300 to 500 acres, occupied by intelligent tenants with sufficient capital, are the best cultivated, and give the greatest proportional profit. Small farms are usually occupied by men who have little more capital than their stock, even if that is their own, free from debt, and consequently have not the means, if they had the inclination, to bring their farms into a high state of cultivation by feeding cattle and purchasing bones, oil-cakes, and artificial manures, on which high farming depends. When a farm is too large, it requires too great a capital, and every portion cannot so well be attended to by the farmer: we mean those which consist chiefly of arable land; for very extensive pastures are more easily attended to, and require much less labour. Most Yorkshire farms have extensive pastures attached to them, where horses and cattle are bred, for which the county is celebrated. The rent of land is moderate, considering its quality, but leases are not common, except where wastes and commons have been inclosed, and the tenants have undertaken to bring them into regular cultivation. In the leases granted there are frequently many conditions and restrictions which are unnecessary and injurious to the tenant, such as not to plant above one or two acres of potatoes, as if on a well-managed farm potatoes were not one of the most profitable crops; and their introduction into the regular rotation on light soils would enable the tenant to pay a better rent. If there must be restrictions, let it be that potatoes shall not recur above once in eight or ten years on the same spot. The exact rotation of crops is likewise laid down in some leases, which entirely precludes any improvement, and takes from the farmer the strongest incitement to cultivate in the best manner. It presumes that the agent or surveyor who lets the farm has discovered the *ne plus ultra* of good farming, which reminds one of a very common saying, when a farmer has failed, that it was not his fault, for he farmed his land as well as it was possible; by which was meant that he followed some old-established routine without deviation, and was ruined in the end.

In some old leases there is a covenant that all the dung, ashes, and manure produced in the messuages shall be spread on the pastures and meadow grounds; than which there cannot be a more absurd clause. Lime is almost invariably directed to be put on the land in a certain proportion, whether the land requires it or not.

Few waggons are used in this part of Yorkshire, owing to the frequent hills; and single-horse carts are found much more convenient and economical, especially where the horses are strong and active.

Threshing-machines were very early introduced from Scotland, and there is scarcely a farm of any extent which has not one: with these machines the labourers undertake to thresh and clean oats at 6*d.* the quarter, and wheat at 1*s.*, the horses being supplied them. The great advantage of having a large quantity of corn locked up at once in a granary and ready to take to market, and not lying about on a barn-floor subject to daily pilfering, is the principal advantage of a machine. It also leaves less corn in the straw, when properly managed. The ploughs are mostly without wheels, and, like the Scotch ploughs, are universally worked with two horses abreast, unless some very stiff soil is to be broken up. The Cleveland horses are very strong and active, and many good carriage-horses are bred from Cleveland mares by giving them a full blood horse.

More modern and complicated implements, such as scarifiers, drills, and horse-hoes, are used by gentlemen and the wealthier farmers; and every new improvement is soon introduced and tried. As much hay is made and put into ricks in the field, it would be a loss of time, in the busy period of hay-making, if it were loaded on carts or waggons, to be immediately unloaded on the rick; it is therefore usually dragged along the ground by means of a wooden frame called a hay-sweep, which is drawn by two horses, kept at some distance from each other, which collect and drag, as on a sledge, a great cock of hay, and, after bringing it to the foot of the rick, leave it there to fetch another. The frame, being lifted up, slides over the heap of hay; and the horses generally trot in the operation.

On an average of farms, the grass land is two-thirds of the whole farm, and the arable one-third; in the drier portions of the Riding, as in Cleveland, the proportion of arable is greater; as you approach the west, it is less, the climate being there better adapted for grass.

In ploughing the land the practice used to be to gather it in high ridges, whether the subsoil was retentive or porous. Since the introduction of under-draining, which, however, is not sufficiently general, these ridges have been lowered and gradually brought to a level, being reduced in width from seven yards to three or four yards.

Clean fallows were once universal on all the heavy soils, and many good farmers still think them necessary to keep clay soils clean and sweet. Wherever a useful crop can be introduced into the fallow years, such as tares sown after the land is worked in autumn after harvest, and cut green or fed off in the next summer in time to allow another cleaning and stirring before wheat-sowing, this is taken advantage of by industrious cultivators. On the lighter loams turnips have entirely superseded clean fallows, and even on the heaviest fallows do not recur so frequently as they did formerly, seldom sooner than after an interval of six years. This is in consequence of the introduction of improved rotations of crops.

The most common rotation on heavy loams is, fallow, wheat, beans and peas mixed, oats, which, if the beans and peas are used for fatting cattle and not sold, is a good rotation, but otherwise too exhausting. The hay produced on the grass land, and given to cattle in winter, may in some measure give a sufficiency of dung to keep the land in heart. On the gravelly loams the Norfolk course is commonly adopted, viz. turnips, barley, clover, or grass-seeds, wheat. Sometimes peas take the place of the clover; they might be profitably introduced between grass-seeds and wheat, as this last does not give so good crops after rye-grass as after clover: and the introduction of peas is according to the right principles of the succession of crops. A curious alternation is practised by some on light soil, which is, turnips and barley, the turnips fed off: and it seems to be a very profitable course. How long it will succeed we will not pretend to determine; but, as with wheat and beans on good loams in Kent, with a careful destruction of weeds, it may succeed for many years. If the turnips continue good, it is a very profitable course. The only manure used for the turnips is lime: bones would be better, and are no doubt employed by the best farmers. The manure is spared for the grass land, a most preposterous arrangement. In the very rich soils of Ryedale several crops of oats are often taken in succession with much success; but, like all very rich soils, they will do so for a time only, and at the expense of the *heart* of the land, and all the future crops for generations to come. It is literally eating up the capital, which should produce a good interest for ever. An old and bad course on heavy lands is still occasionally met with in Cleveland, which is, fallow, wheat, oats, and clover left two years: by merely transposing the two last, or taking oats after the fallow and wheat after the clover, the same crops would give a greater return, and leave the land clean. Oats after wheat must fill the land with weeds, and the clover cannot possibly thrive in foul soils.

There is no part of England where lime is so much used on the land as in Yorkshire; but, however advantageous this may be on some soils, it must evidently be thrown away on others, if it does not do harm by exciting the land to bear crops, and exhausting it of its natural organic components. On land which has been long in grass, and where the soil contains little calcareous matter, lime is extremely beneficial; but upon poor hungry soils, unless a good dressing of rich dung be given at the same time, it does more harm than good. Wheat is generally sown in the first week of October.

although some continue to sow it in open weather till March, as the turnips come off, and have good crops, if the summer be not too wet.

The corn, when not mown, is reaped with the sickle, generally by women; the men seldom reap, but they often tie up the sheaves, one man tying for three women; sometimes a boy makes the bands for him. The sheaves are set up in tens, two sheaves being turned over them as a protection from the wet. In rainy weather this may be advisable; but if the weather is fine, it is much better to let the ears have the advantage of the sun and morning dews; even a few showers will not hurt the corn after it is in sheaf. The best wheat is grown in Cleveland, but the crops are not so abundant as those in Ryedale, where the turnip-system is more general, instead of fallows. Much wheat is exported from the ports of the North Riding, chiefly to the manufacturing districts, besides what supplies its own population; but, till of late years, oat and rye meal were the chief food of the labourers, as well as meslin, that is, wheat and rye sown together, which makes good wholesome bread. On the good light soils as much as six quarters of rye per acre has been grown. The barley of this Riding is not particularly fine, nor the crops large. It seems as if the land was better suited to rye and oats: the reason of this it may be more difficult to explain; it arises probably from the natural texture of the soil, more than from its composition. The quantity of barley sown is usually ten pecks, and the crop averages four quarters per acre.

Ryedale is remarkable for its fine oats, which are usually sown on the turnip land, or on the grass land when ploughed up. The sort is generally the Friesland oat, and the quantity of seed is from four to five bushels per acre. On some of the best lands they sow as much as eight bushels, which appears enormous, and probably diminishes the crop by weakening the stems, which grow too close. The idea is, that on good land, the more seed the greater crop, which is by no means a necessary consequence. The farmers are particular in getting a change of seed from Holland every four or five years. Oats are sown in March and April, the earlier the better, if the weather permits. Eight quarters per acre is an average crop in Ryedale. The oats are threshed out soon after harvest, as new oats make the best oatmeal, to which purpose they are chiefly applied. A quarter is supposed to weigh twenty-four stones, and is often sold by weight, instead of measure, at this rate.

Rape is sown extensively for seed on the best lands, and the preparation is often by paring and burning grass lands, which is sure to secure a crop. The seed is sown in July or August, and the plants thinned out or transplanted in October. Where there is a great breadth of rape, the plants are raised in seed beds, and transplanted with the plough. A furrow is made, and the plants are placed a foot apart, leaning on the furrow-slice turned over; when the plough returns, it covers the roots, and the plants stand upright: should the soil be very loose, a woman treads by the side of every plant to fix it; a shower of rain renders this operation superfluous. Rape is usually ripe in July, and threshed out on a cloth in the field, by which much shedding of the seed is saved. It should be cut before the pod is quite ripe. These threshings are a kind of festival, like hop-picking in hop countries, and draw together many labourers and more idlers; but the work must be finished rapidly in so precarious a climate, for a wet day would spoil all. If there is much seed, great care must be taken that it do not heat too much in the heap. This inconvenience is avoided where the rape is stacked in the straw for some time before it is threshed; but then it must be very carefully handled in the stacking and carrying, or much seed will be shed and lost. When it is in stack, the outside is beaten with poles, a cloth being laid under the part which is beaten. This beats out the seeds; they would otherwise soon be devoured by the birds, which are very fond of them. In carrying rape, a cloth is spread over four poles, one at each corner of the waggon, forming a bag to catch the seed; there are also light barrows with cloths over them, to carry the sheaves to the waggon or stack. The straw and refuse of the rape is excellent fodder for the cattle in winter. It is therefore waste to burn them in the field, as some do. The crop usually averages the same as wheat: but the price fluctuates greatly. To be a profitable crop, it should not be less than the price of wheat.

Turnips used to be sown on grass land pared and burnt, or ploughed two or three times after having been fed off late in spring; but now the usual cultivation of this root on the Northumberland plan is generally adopted, with a very careful preparation and manuring.

Potatoes are become a very essential crop on many farms, and are mostly shipped to London, where they fetch a good price. The Yorkshire reds are a favourite sort in the market. The sets are generally cut: but it is found by experience that a more certain crop is produced by selecting middle-sized potatoes and planting them whole. Twenty bushels are required to plant an acre in rows at twenty-seven inches' distance and eighteen inches apart in the rows. Twenty loads of good dung should be given to the land, and spread in the furrows when the sets are put in. The deeper the ground has been stirred the better; but the high moulding up of the stems, as they grow, is not found so advantageous as merely stirring the intervals and keeping down the weeds. The produce is from 200 to 300 bushels per acre; 400 have been obtained, but this is a very great crop.

The opinion that potatoes greatly exhaust the land has led some proprietors to prohibit the cultivation of them to any extent; but if the above-mentioned quantity of dung is given to the land, there will be no fear of exhaustion, and the subsequent crops, which should be spring corn, and not wheat, and clover or grass seeds after this, will show no diminution of fertility. Potatoes leave the ground too loose for wheat, which is apt to be thrown out by the frost: by leaving the land exposed to the frost, and sowing in spring, it will be both rich and mellow, and the spring crop and young clover will grow well. A farmer cannot afford to have a great breadth of potatoes, when each acre takes 15 to 20 tumbril loads of dung. Many experienced men think that Swedish turnips are more valuable as a crop, and raised at less expense.

A little flax is still sown, but not in the quantity it was once, when domestic manufactures had not yet been destroyed by the power of steam and machinery. The competition of the foreign flax-grower makes this branch of agriculture less profitable than it was once. It is to be hoped that in time it will revive.

A considerable quantity of mustard is sown in the neighbourhood of York, which is ground and sold as Durham mustard.

The principal part of the North Riding consists of grass lands, and is appropriated to the dairy, which is but poorly managed in the vale of York and other parts of the Riding. The grass lands are laid down in high broad ridges, so that the upper part, being too dry, is covered with moss and poor herbage, and the low intervals are full of rushes and aquatic plants, a necessary consequence of this mode of ridging. They are thus left, when they might be improved by cultivation, partly from the prohibition to break up pastures, and partly for fear of the tithe-owner, if they are cultivated. This last reason exists no longer, and a great blessing it is for all parties, for although the fear of the tithe-owner was often a mere bugbear, it still impeded improvements.

In the dales of the Western Moorlands the meadows are more carefully managed. The weeds are eradicated, and the grass is regularly manured by top-dressings. This is done in spring or autumn; in the last case the pastures are not fed off close before winter, by which the surface might be chilled by the frost: but an early bite in spring compensates the loss fully. It is thought by some dairymen that the butter made off poor pastures is firmer and keeps better in long voyages, than where the pastures are very rich and the grass succulent. This however is contradicted by the quality of the Dutch and Holstein butter, where the pastures are very rich. Artificial grasses are sown chiefly to make permanent pastures. They consist chiefly of white clover, trefoil, rib grass, and hay-seeds, as they are called, which are only the sweepings of haylofts, in which some seeds of the early grasses may be ripe and vegetate; but much the best mode is that of collecting grass-seeds by hand, and sowing them in just proportions, to produce a good sward. If these cannot be readily obtained, it is better to sow some perennial rye-grass, about two bushels per acre. In making hay, in the West Moorlands, where this is done in a better manner than in other parts of the Riding, the grass is tedded out with the hands, by which it is better divided; it is turned over, as soon as the top is dry, with the rake-handle, and then raked into windrows, and made into small cocks, called foot-cocks, the same day. After the dew is off the next day, these cocks are opened to the sun and wind; this again is done with the hands. As soon as it is sufficiently dry, these are raked together, and either stacked at once, or, if there is a large quantity, and the weather is precarious, they are collected into large cocks, where they slightly heat, before they are carried to the stack; but this should be avoided if possible, as some of the bottom of the cock is always more or less damaged by the moisture rising from the ground; besides, being considered as safe in these cocks, it is often left too long in the field, and sometimes no sufficient interval of dry weather occurs to stack them in good order. The dairy and fatting cattle and sheep are usually sent to the pastures about the 12th of May, till October, when they are removed to the after-grass, or fog, as it is called; the pastures are then stocked with lean shorn sheep, and kept bare all winter—a very bad practice, which impoverishes the land and encourages moss. All pastures should be mown once at least in three or four years, to improve the grass and destroy rank weeds.

There was once a fair proportion of timber-trees both in the woods and hedgerows of this Riding; but they have been much thinned, and at present the quantity is inconsiderable, as well as their size. Ash still abounds in the dairy districts, being useful for butter-firkins and other dairy implements which require a white wood.

The short-horned breed of cattle is the prevailing sort all over Yorkshire, and of this there are some varieties. Those of Cleveland and the vale of York are known by the name of the Teeswater breed, and in England are called the Holderness breed. They originally came over from Holland, and are very profitable where the pasture is rich; but on poorer land they soon degenerate. Oxen are fatted to a great size, and seldom used for draught. In the West Moorlands the cattle are smaller, and on the borders of the West Riding and Westmoreland the long-horned breed is very common. A cross of the two breeds has been praised by some, but it is doubtful if anything very good could be produced by it beyond the first progeny between them. It would not be advisable to rear a bull of the cross, however he might appear well shaped; the continued cross will invariably introduce defective points. Many heifers and cows of the Teeswater breed are sent to the dairymen in London. They suit them, by bearing close confinement well; giving much milk, although not so rich in cream as some of the smaller breeds. A fine heifer with a calf by her side, or ready to calve, will fetch 20*l.* or more, which pays well for her rearing. Yorkshire cows have a great flow of milk, and sometimes it is difficult to dry the old milk in proper time before calving, or when they are put up to fatten. Saltpetre given to cows, an ounce or more at a time, after bleeding them, seems the most efficacious remedy, and soon diminishes the milk. They should at first be milked only once a day, leaving some milk in the udder at each milking; and they should only be relieved when the milk seems to accumulate, and might cause inflammation in the udder.

The old Teeswater breed of sheep is large and coarse, feeding to 30 lbs. and even 40 lbs. per quarter at three years old, and producing 10 lbs. or 11 lbs. of wool; but the breed has been much improved by crosses from the Dishley breed. The wool and carcass have both been much improved by it. The sheep on the Western Moorlands are horned, with grey faces and legs; and many of them have a black spot on the back of the neck; their wool is coarse. The breed of horses all over Yorkshire is well known and highly appreciated. In no county are so many valuable horses bred, especially carriage-horses and hunters, which fetch great prices. For carriage-horses, Cleveland bays are in high repute when they have some blood. In the dales of the Eastern Moorlands and on the coast many useful horses are bred, of a moderate size and very compact, which suit the manufacturing districts. They are often a cross of the Scotch galloway and the larger Yorkshire horse. Some large farmers buy colts three years old, and work them moderately till they are six, when they are sold for carriage-horses or for the saddle: by this means they often have all the work done for little or nothing, the improved price paying for the keep of the horse. Mares are used very generally for farm work, and are made to give foals every year. They are worked till a few weeks before foaling, and again a few weeks after, the foal often following the team or the plough when of sufficient age. They generally drop in May, and are weaned in October, when they can live in the pastures. The practice of making up horses for sale is too well known to need a description. Yorkshire dealers are notorious for their art in hiding natural defects in horses; but as this is well known, every purchaser takes his precautions, and has good advice if he is not skilled himself: if he is ignorant and conceited, he will probably be taken in and then laughed at. Yorkshire pigs and hams are celebrated, but it is not in this portion of the county that they are the best. We will notice them in the other Ridings.

Many of the observations made on the agriculture of the North Riding of Yorkshire are equally applicable to the whole county, and consequently need not be repeated: we shall only notice those points which are peculiar to each Riding. The *East Riding* of Yorkshire extends along the German Ocean, from the river Hartford southward to the Humber, having part of the North Riding and the Ainsty of York to the north and west, and the West Riding to the south-west. The length of this Riding from the south-east to north-west is 52 miles, and from south-west to north-east 42 miles, containing above 800,000 acres, mostly cultivated. The high hills called the Wolds are cold and bleak, from their exposure and want of shelter; but they are healthy, and form strong robust constitutions; and although the winters and springs are cold, the soil is fertile, and the crops generally abundant, especially in very dry seasons. There is a moisture arising from the chalky subsoil which is very favourable to vegetation. The Wolds, however suited to pastures and spring corn, produce no good wheat: the crops of this grain, when attempted, are small, and the sample of the corn coarse and thick-skinned. In Holderness, on the contrary, where the land is sheltered and the soil fertile, abundant crops of excellent wheat are raised, and the flat rich pastures along the Humber are equally remarkable for good grass. The climate on a level with the sea is much milder.

Howdenshire, with Ouse and Derwent, which district comprises all the country to the south of the Weighton and York road, and west of the Weighton and South Cave road, being situated inland, and sheltered by the Wolds from the north-east, have an earlier climate than the districts nearer the sea, although the frost and snow are of more continuance in winter. The sea air tends to keep a more regular temperature, cooling the summer heats, and moderating the cold frosty winds in winter. Chalk forms a principal portion of the substratum of the southern part of the island, but disappears in a bold lofty front to the north of this Riding. It occupied a great portion of the centre of this Riding from the Humber to Flamborough Head.

The soil of the Wolds is a light friable calcareous loam over a chalk rubble, which covers the solid mass of chalk. There are flints in the soil, but not of such a size and in such quantities as in other chalk districts in the south. On the banks of the Humber there are above 14,000 acres of warp land, a stiff clay of extraordinary fertility. [Warping.] A certain proportion of fine sand in the warp is essential to its greatest fertility. Sunk Island, now a most fertile spot, was once a mere sand-bank in the Humber. It now contains 4700 acres of fertile land; a chapel has been erected upon it, and the embankments are gradually increasing. It is now a part of the coast, although ships once used to sail round it. To make up for this increase of land, the sea has gradually carried away whole villages and farms along the eastern coast from Bridlington Bay to the Spurn Point, a distance of thirty-seven miles.

A large tract of poor sandy land extends in a north-west direction from South Cave nearly to York. Parallel to this and along the Ouse lies a tract of a very fertile alluvial soil, fit for any kind of agricultural produce. In the vale of Derwent the soil varies greatly. The East Riding is very well watered; the Derwent, being navigable from its junction with the Ouse to Malton, greatly facilitates its communications. The railway lately made from Hull to York is a great advantage to trade, although the Ouse forms a ready communication for heavy goods from York to the Humber. There are several smaller rivers, but not so navigable.

The farms in the East Riding are of considerable extent, and so are the estates. The farm-houses are comfortable, except in the Wolds, where they are of a very inferior kind, excepting those which have been erected within a few years by judicious landlords; but the application of fancy styles, such as the Gothic or Elizabethan, to farm-houses and labourers' cottages, justly exposes the proprietors to ridicule, being quite incongruous. The labourers' cottages are generally comfortable, and chalk is a cheap material to build them with, besides being dry and wholesome.

Leases are not generally granted; but a tenant who pays his rent and cultivates well is seldom turned out. In very fertile soils this may be of less consequence; but no inferior soil was ever permanently improved without the security of a lease. Agreements in writing, with special conditions, are very general, in order to avoid disputes arising from verbal agreements. The rotations and succession of crops in the East Riding are similar on similar soils to those in the North Riding, and need not be repeated here. The wheat is usually mown with a cradle-scythe. The produce on the best soils is from thirty to forty bushels per acre; sometimes considerably more.

There is a peculiarity in the harvesting of oats in this Riding which is worthy of notice. The oats are cut by the sickle, as wheat is elsewhere; the sheaves are tied loosely, very near to the corn, and the butts are spread out and set singly and upright, so that the wind readily finds access to dry them. Some time after a fresh band is made, and the first sheaf is tied round the middle, while the upper band is loosened; this serves to bind the next sheaf, and so on. There is a little extra labour in this mode of tying, but it is well repaid in a moist climate by the condition in which the oats thus treated are stacked, and by the goodness of the straw, which otherwise often acquires a musty taste in the stack, even if the oats are not injured.

Beans are a profitable crop in the heavy soils of this Riding. The old rotation used to be—fallow, wheat, beans; and where sufficient manure could be obtained from the stock fed on the grass land and on hay in winter, it was not unprofitable. The fallows were well worked, manured, and limed, and the crops were good, while the land was improving; but a better practice has succeeded, which is, to take the beans first, plant or drill them in wide rows, and horse-hoe them repeatedly. No crop pays better on heavy land for manure and lime; and the wheat sown immediately after is generally good. If the beans are kept very clean, the fallow becomes unnecessary, and may be deferred until the state of the land absolutely requires it. This improved practice, however, is by no means generally adopted; and in some of the richer soils in Howdenshire beans are still sown thick and broadcast, so that hoeing them is out of the question, and the crop is often choked with sow-thistle and other rank weeds, which abound in such soils. No wheat can be expected after such a crop, and a fallow is indispensable. Spring tares are sometimes sown with the beans, in the proportion of half a bushel to three and a half of beans. The seeds are easily separated by the sieve when threshed. This mixture is good when beans are sown to be cut up green, to give the pigs and cattle; a very excellent practice, which ought to be more common on heavy soils. The weeds then are choked, and have no time to ripen their seeds, and the ground may be admirably prepared for wheat by a bastard fallow, as it is usually called.

Rape is extensively grown in Holderness both for sheep-feed and for seed: in the first case it is generally succeeded by wheat; in the latter, by oats. The time of sowing is about the middle of June; the quantity of seed half a peck per acre. Rape and cole-seed are often confounded, but the rape shoots up straight stems, and is better calculated to be fed off: the cole-seed makes the best oil at the mill. If rape be sown early in spring, it will seed the same year: cole is a decided biennial. About Hedon, Patrington, Sunk Island, and other rich warp lands, much cole-seed and rape-seed are raised, which are sent to the oil mills at Hull. On breaking up the sheep-walks on the Wolds, rape is often successfully grown; but it may be doubted if so exhausting a crop be not too much for thin poor lands which have only the temporary richness produced by the roots of grasses, and are readily exhausted. The organic matter cannot well be restored by manure, from the distance of the Wold pastures from the homesteads and villages.

Sainfoin has been introduced wherever the subsoil is chalk, where it is an invaluable plant. The mode of cultivating sainfoin has been fully given in SURREY (Agriculture of), to which we refer. Potatoes are very extensively cultivated in Holderness and Howdenshire. Those grown upon the warp lands are preferred in the London market to those grown on the sandy soils. The best sorts have been long known by the names of Red-nose kidney, Flat white, Purple kidney, and Cape kidney; the Green top and Ox noble are very productive, but better suited to feed cattle with than for the table. They are cultivated, as we described, in the North Riding.

Swedish turnips, cabbages, and carrots are grown in the soils which suit them, with much advantage for feeding cattle and sheep in winter.

Buckwheat is advantageously grown in the sandy soils; it is sown in June and reaped in October; it draws little from the soil, and is an excellent smotherer of weeds, which makes it a good preparation for turnips.

In the East Riding the proportion of grass land on the farms is much less than in the other Ridings. Most of the pastures have been ploughed up, even on the Wolds; and those only which lie low along the rivers have been left as permanent meadows. The salt-marshes along the sea are very useful, especially to recover horses which have been overworked. Sheep likewise get fat on them after a time, the first effect of the salt pasture being to purge them; but once recovered from this salutary preparation, they fatten rapidly.

There is but little timber in this Riding, either in woods or hedge-rows. The Wolds are naturally quite bare of trees; and in the rich alluvial soils the tenants and proprietors have generally been wise enough not to plant the hedge-rows. Some plantations have been formed on the Wolds, but they contain little useful timber.

Draining, on a very extensive scale, has been done in Holderness and other flat and low parts of the Riding, by which low and marshy grounds have been rendered fertile. Works have been erected at great expense under the authority of several acts of parliament, from 1762 to the present day. In 1811 the sum expended on the drainage of two levels, the one extending from Fosten to Barmston, and containing 2136 acres, and the other from the same point to Wincolmlee near Hull, containing 10,432 acres, amounted already to 135,000*l.*, the interest of which was barely repaid by the improved value of the land drained. This implies some want of care and economy in the commissioners, and something like jobbing in the contractors. The drainage of 10,500 acres, called the Hertford and Derwent drainage, part of which is in the East Riding, cost 41,612*l.*, or about 4*l.* per acre only. This pays the proprietors 21 per cent. on their outlay. Other less extensive drainages have been executed, much to the improvement of the country.

Near the sea-coast *wreck*, or sea-weed, is very extensively used for manure; and after a storm the farmers' carts may be seen busily employed at low water to collect it. It is laid in heaps, where it soon ferments, and, as soon as convenient, is carried on the land; if left to rot, it would waste away and be of little use. The fresher it is carried on the land the better. It is excellent for turnips. Bones are now extensively used on the lighter soils, and many cargoes are annually imported from the Continent into the port of Hull for this sole purpose.

Holderness cattle have been mentioned before, and scarcely any other breed is found in the East Riding. They are evidently of Dutch origin, perhaps through Holstein, where they have also been introduced from Holland. When care has been bestowed on the breeding of the heifers, they are a finer race than the Dutch, with less bone and better proportions; whether the quantity of milk is increased, is not quite so sure; but the fatting qualities certainly are, which are of more importance in a district where breeding and fatting stock is generally preferred to dairying.

On the rich pastures the improved Leicester breed of sheep is found the most profitable; on the Wolds the South Downs have been introduced with great success. Crosses have been attempted, but, on the whole, the pure breeds pay best for their food.

No part of England produces so fine and valuable horses as the East and North Ridings of Yorkshire. We have mentioned the Cleveland bays. The introduction of full blood into this breed has produced some clever hunters, which have been sold at high prices; but, for the carriage, many still prefer the pure Cleveland bays without a cross. They are compact, hardy, and of good courage, and can stand a hard day's work better than the half-bred horses, which require much good grooming. Another cross which has been attempted, and which must be altogether reprobated, is that with the large Lincolnshire hairy-legged cart-horse. This is quite incongruous, destroying the very point in which the Cleveland bays excel, which is the absence of hair from the legs, and the neat clean look which the jet black, shining, and smooth appearance of the skin on the fetlocks gives them. The agricultural labourers are well off in general in the East Riding: they often board with the farmers, and are at work early and late. When their wages tempt labourers from other counties to seek work here, they soon find that they have not so easy a life as they imagined; and few men of other counties can compete with the Yorkshireman in task-work. The abundance of fuel in most districts is a great advantage to the poor.

The *West Riding* of Yorkshire is situated nearly in the centre of the kingdom; but, from its numerous rivers and canals, has a free intercourse with the east and west coasts. On the east it has the Ainsty of York and the East Riding, from which it is separated by the river Ouse. The counties of Nottingham and Derby are on the south, and on the west are those of Lancashire, Chester, and Westmoreland. The North Riding forms its northern boundary. It is 95 miles long from east to west, 48 from north to south, and contains about 1,500,000 acres of land.

In so great an extent the soil and climate naturally vary. It is in general dry and healthy. The eastern and northern portions are similar to the Ridings so situated, while the west partakes of the moist and hilly nature of the counties bordering on the Atlantic. We have entered so fully on the agriculture of the North and East Riding, that we shall only observe that a great part of the West Riding is in pasture, the arable land being chiefly found on the northern and eastern portion, where it is cultivated much in the same manner as in the adjoining Ridings. An elaborate account of the West Riding was drawn up from the original survey made in 1793 for the Board of Agriculture, by Mr. Robert Brown of Markle, to which we must refer for particulars.

As grazing is well understood in this Riding, much cattle is purchased to be fatted here, but not many are bred; consequently a much greater variety may be observed in the stock than in the other Ridings. The manufactures, which have rapidly sprung up, and cause a great demand for butcher's meat, are a great encouragement to the grazier. The grass will nearly fatten an ox in summer, which formerly would have been considered as quite ripe for the butcher; but with the addition of turnips and hay in autumn they are made very fat, especially with the help of linseed cakes, which is sometimes succeeded by oatmeal and hay for the last ten days, in order to avoid the flavour which some very delicate palates discover in beef fed with oily food. Many hogs are fatted in this Riding, the hams being cured for the London market, while the fitches are readily disposed of among the manufacturers, who never find bacon too fat. This Riding was formerly better wooded than the rest of Yorkshire; but the forests have been destroyed, and the land divided and cultivated. There is a considerable demand for oak and ash of small size, for the use of the mines and collieries. Much land in the Riding is fit for little else than planting firs and larch; and where the latter wood has thriven, considerable profit has been made in a few years by well-managed plantations.

The properties and farms in the West Riding are generally smaller than in the other Ridings, and there are more freeholders, which is not so favourable to improvements as if they were of greater extent, and held on lease under liberal landlords. The small freeholder has seldom capital to lay out on his land, and, having no rent to make up, is satisfied if his farm feeds him and his family, which it often does but scantily, after very hard labour, such as a tenant holding a large farm would disdain to submit to.

SUPPLEMENT

TO THE

DICTIONARY OF THE FARM.

⁂ It has been considered desirable to introduce, as a Supplement to the Rev. Mr. Rham's article on "Manure," some new and additional information, particularly on "GUANO."

SUPPLEMENT, &c.

MANURE.—In the article under this head, in the 'Dictionary of the Farm,' it is observed that, "The experiments which have hitherto been made on artificial manures have not been sufficiently varied to lead to any accurate conclusions as to their comparative merits;" and practical farmers are recommended "to note down every particular in the formation and application of the manures which they employ, and also their apparent effect." This has been done to a great extent within the last two or three years, and considerable progress has consequently been made in establishing data from which just conclusions may be drawn. We propose to give some account of the principal artificial fertilizers, and to select such examples of the results obtained from their application, as will assist the practical farmer in his experiments. The principles to be kept in view have been already explained in the 'Dictionary of the Farm;' but the experimentalist will derive advantage by having under his eye the results obtained by others. He will thus at once see what has been done by those who preceded him, and be able to follow the course which they have pursued, or modify it, according to circumstances.

First in importance amongst the "fertilizers of commerce" we must undoubtedly place *guano*, of which there are two kinds; that from Peru and Bolivia, and that from the coast of Africa. The word guano is the Spanish mode of spelling the Peruvian word *huanu*, which signifies dung. It consists of the excrements of sea-fowl, and was used as a manure in Peru by the aborigines probably for ages before the country was visited by the Spaniards. It is mentioned by Herrera, in his work published at Madrid in 1601. Garcilaso de la Vega, in his 'Memoriales Reales,' published at Lisbon in 1609, notices the accumulations of guano on the coasts of Peru. He says, "On the sea-coast from below Arequipa, as far as Tarapaca, which is more than 200 leagues of coast, they use no other manure than that of marine birds, which exist both great and small on all the coasts of Peru, and go in flocks perfectly incredible, if not seen. They are reared on some uninhabited islands which exist on that coast, and the manure that they leave is of inconceivable amount. At a distance the hills of it resemble the mounds on some snowy plain. In the time of the Incas there was so much vigilance in guarding these birds, that during the rearing season no person was allowed to visit the islands under pain of death, in order that they might not be frightened and driven from their nests. Neither was it allowed to kill them at any time, either on or off the islands, under the same penalty. Each district or territory also had a portion of these islands allotted to it, the penalties for infringement of which were very severe." The prodigious masses of guano in this part of South America are noticed by Ulloa, in his 'Voyage,' published in 1741. "This," he says, "is the manure used in fields sowed with maize; and with proper waterings, is found greatly to fertilize the soil, a little of it being put to every stem and immediately watered. It is also in use for fields of other grain, except wheat and barley." A recent German traveller, Meyer, in his 'Reise um die Welt,' says, "The top and sides of the Morro de Arica, on the coast of Peru, appeared, as we have already seen them from the open sea, of a white colour; but we had been mistaken in supposing that such was the colour of the rock. This white coating is the celebrated fowls' dung, the guano of the Peruvians, which has excited so much attention in recent times. Along almost the whole coast of South Peru this excrementitious matter covers the small islands and cliffs near to the coast; and, on some spots, lies in such enormous beds as could only be produced by the accumulation of thousands of years. It is derived from the immense multitudes of the larger sea-fowls which inhabit this coast, and which belong chiefly to the genera of pelicans, cormorants, and gulls. Their number is legion, for, in the true sense of the word, they eclipse the sun, when, early in the morning, they take flight from their resting-places in flocks that are miles in length. One must have seen them in order to form an adequate idea of their numbers; and then it becomes conceivable how, in particular places, such vast masses of this manure are yearly dug up. M. Rivero estimates that the islands Hay and Jesus alone yielded annually 500 fanegas of this fresh birds'-dung. This guano is an article of commerce of great importance, particularly as in the southern maritime provinces of Peru, where a great want of water prevails, the soil is very sandy, and requires to be manured previously to being tilled. The extraordinary fertility which birds'-dung, with sufficient irrigation, imparts to the soil, is equally well known to our countrymen in Europe; in Peru the produce of the fields is doubled by it. According to the age, and perhaps also according to the different kinds of fowl that yield it, the guano is found of different colours and quality; so that it has been divided into three distinct varieties, namely, the red (guano rojo), the brown (G. perdozco), and the white (G. blanco), which also bring different prices. The red and brown kinds sell at one dollar and a quarter the fanega (two quintals and a half), while the fresh white fetches two dollars, and in time of war still higher prices. . . . . The birds which yield the Peruvian guano are known by the general name of Heanac."

Mr. Thairwall, of Richmond, Yorkshire, who has visited the western coast of South America, describes the Chinca Islands, a scattered group, on this coast, in 13° 44′ S. lat., about 12 miles from the small port of Pisco, as being those from which the best guano is obtained. One of these islands is about three miles in circumference and supposed to have a uniform elevation of about one hundred feet. On this the guano lies piled up in a solid mass, two hundred feet in depth. The surface is coated over with a thick incrustation of almost pure muriate of ammonia; and when the bulk is disturbed, the ammonia given out is so strong as to affect respiration, and to cause an unpleasant sensation to the eyes. The guano is extensively used as manure, and, aided by irrigation, for rain is unknown, produces year after year luxuriant crops, without intermission. "The soil is a fine rich loam; after being thoroughly cleansed and prepared for the seed, the guano is sown over at the rate of from 300 lbs.. to 400 lbs. per acre, at a rough calculation; it is then lightly turned in, that the soil may perfectly take up the ammonia, the seed sown, and afterwards the whole laid under water, and repeated as required."

Another account of the mode in which guano is used in Peru, states, that in the neighbourhood of Arequipa it is applied chiefly, or almost wholly, to land in which potatoes and maize are grown. "The time for applying guano to the maize is when the plant is about two feet high: then a small quantity of it is dashed round the plant on the surface of the ground; a labourer immediately follows with a spade, throws up the earth round the bunch of stalks in the form of a mound, with the double object of covering the guano and supporting the plant, which, after being watered, is apt to fall when there is any wind. A single handful is sufficient for the roots of three different bunches of stalks. Water must be let on within three days after the guano is applied, otherwise it does injury to the root. To potatoes it is applied after the plant has risen a few inches out of the ground, in about the same proportion as is used for maize; but, instead of being thrown on the ground, it is placed near the level of the roots by first making small holes. The ground must be irrigated within two days after, otherwise the roots are, if not destroyed, considerably injured by the guano."

The guano of Peru and Bolivia is imported only by two co-agents, one in London, and the other at Liverpool. If the governments of these countries did not take steps to prevent the guano being taken without authority, the accumulation of centuries would be carried away in a year or two. Besides the guano from South America, large supplies have been procured from Ichaboe. This island is about two miles and a half from the mainland of Africa, in 26° 13′ S. lat. and 14° 15′ E. long., and about four days' sail from the Cape of Good Hope. It is a barren shelving rock, about a mile long, and half a mile across at its broadest part. The guano was about 35 or 38 feet deep, and deposited on a part of the island which formed a flat shelf about 1100 feet long, with an average width of 400 feet. There seems reason to believe that this deposit did not consist solely of the excrements of sea-birds, but that it was mixed with other matter, as the decomposed bodies of marine birds and animals, and the excrement of both. Owing to the heavy surf, the difficulty of landing at Ichaboe was very great, and in consequence of strong winds the number of days on which boats could pass between the shore and the ships did not average more than three a-week; and it usually required three months to take in a cargo. Guano has also been procured from some other islets on this part of the African coast. An account of the African guano deposits was first published in an American paper, which was transmitted by the captain of an English trader to his relatives at Liverpool, who, at the close of 1842, fitted out five ships, for the purpose of bringing home cargoes. The situation of the islands was so imperfectly known, that four of the ships were unsuccessful in their search, and only one (the Anne, of Bristol) reached Ichaboe, through information accidentally obtained of the captain of an American whaler. There were soon a large number of ships employed in the trade, and as many as three hundred and fifty have been anchored in the roads at one time. There were no regulations for conducting the trade but such as were instituted on the spot by a host of agents and supercargoes who arrived on the island in the first six months after it had been resorted to; and these persons endeavoured to establish a monopoly of the guano. They marked off the ground, and laid claim to all the best parts of the deposits on behalf of their employers in England. They also erected loading stages, and let off pits at extravagant rates. The tents in which the agents dwelt were called Supercargo Town. When an agent had a ship at his stage he delayed the operation of loading under frivolous pretexts, until another ship from his house at home arrived to take its place at the berth, although there might be two or three hundred vessels waiting for a cargo. A committee was formed, of which one of the supercargoes was chairman, and another secretary, and having always ten or eleven ships consigned to them, they contrived to have always five or six of their captains as members. Squabbles and contests were the result of this system, until the captains of ships who suffered from its injustice resolved to put an end to the monopoly of the supercargoes. About three hundred of them agreed to send a proportion of men ashore fully armed; Supercargo Town was attacked by about 1400 men, and its entire population driven into the sea at the point of the bayonet, and when up to their chins in water, they were compelled to swear that they would relinquish the right which they claimed to the sovereignty of the island. This summary change, or revolution, as it may be called, put an end to the monopoly. At another period in the brief history of Ichaboe, the labourers and workmen employed in the pits constituted themselves into a sort of sovereign authority. They elected one of their number, the best boxer on the island, 'King of Ichaboe.' One of his royal ordinances was, that every wheelbarrow which carried more than three bags of guano should be burnt, and accordingly upwards of four hundred were committed to the flames. He had next the audacity to declare that no guano should be shipped, unless seven or eight shillings per ton were paid to him and his men as a sort of export duty. At length the ephemeral authority of supercargoes, of ship-captains, and of labourers, was put an end to by the arrival of a ship of war, the commander of which clapt the 'King' in irons, and enforced judicious regulations without favour to any party.

All the guano deposit of Ichaboe had been carried away at the commencement of 1845; and it is once more restored to the dominion of the sea-fowl.

It is stated in the circular of a guano importer, dated 1st of March, 1845, that "up to this time no island has been discovered to supply the place of Ichaboe, which renders guano an article of safe investment for next year," and some other assertions are made, which are calculated to serve the interest of importers rather than that of purchasers of guano. But it is not true that no fresh source of supply has been discovered. Towards the close of 1844, another guano island (Malagos) was discovered at the entrance of Saldanha Bay, and a survey of it was ordered by the government of the Cape of Good Hope. The guano covers an extent of about eight miles, and gradually increases in thickness from four yards to about eight yards. In this case strict regulations will be laid down, so as to prevent the squabbles that occurred at Ichaboe. Licences are to be issued by the collector of customs at Cape Town, to masters of vessels, of any nation, to remove the guano, upon payment to that officer of one pound sterling per registered ton (new measurement) of the vessel named in the licence. The guano is to be dug in vertical portions from the surface to the rock on which it rests, and in such parts only of the island as shall be appointed by the government officers. Priority of loading is given in the order in which the licences are dated. These regulations are dated Cape Town, Nov. 5th, 1844. From this new source therefore a large supply of guano may be expected, but no cargo has up to this time (April) reached England; and when it does arrive, its value as a fertilizer must be determined by accurate analysis, for Malagos island may not possess the dry climate of Ichaboe, in which case the guano would lose some of its most valuable properties.

It has been supposed that the excrement of the sea-fowl which swarm on the coasts of Caithness, Sutherland, Orkney, and Zetland, the Western Isles, and other parts of the coasts of Great Britain might be available as a fertilizer. Some of the guano collected from an island near Incholm, which in appearance resembled dirty lime, was found highly beneficial as a top dressing for a garden. On the Flamborough Cliffs, on the Yorkshire coast, the dung of sea-birds has been collected, which resembles the dark guano. There are recesses in the rocks where it is many feet deep, and experiments have been tried with it; but the results have not yet been published. It will probably be found that the rains and damp of our climate have deprived British guano of the valuable qualities which the foreign guano possesses; but if it should prove efficacious, the quantity accumulated on our coasts is probably not large. In Britain it is washed away by the rains; but in South America and Africa the dryness of the climate allows the deposits to accumulate; and the heat of the sun produces a coating of the surface, which prevents its essential qualities from being dissipated.

In a sample of genuine African guano examined by the microscope, there was found:—1. Portions of muscular fibre. 2. The speculæ of sponges. 3. The skeletons of animalcules. 4. Crystals of various salts. (Paper by E. J. Quekett, Esq., before the London Microscopical Society.) The goodness of the guano is not always in proportion to the quantity of crystals. Some of the crystals were found in the medullary cavities of the bones of birds, and these contained sulphate of potassa and ammonia. Mr. Quekett proceeded to show that the ammonia was probably derived from the decomposition of the flesh of the birds, and the potassa must be obtained from the food of the bird, probably fish, which derived it in small quantities from sea-water. The muscular fibre was from the flesh of birds and fish, the latter being excrementitious. The speculæ of the sponges and the skeletons of the animalcules were undoubtedly voided after having been taken into the stomachs of the fish, and then into those of the birds as food. "Such transformations," observes Mr. C. W. Johnson, "are not a little curious to follow; for (to give a rough instance) the same particles of phosphate of lime, which once, in some vegetable substance, floated down the waters of a river, after entering into the composition of the bone of a fish (which was devoured by a bird and again carried on to the land), form a portion of the guano which is now spreading over the soil of merry England, to enter into the composition of other vegetables, and other animal substances."

Guano even when genuine differs a good deal in quality; but the principal danger to be guarded against is adulteration. Mr. Gyde, of Painswick, was asked to become agent for a so-called guano, which he discovered "consisted of a mixture of red marl and old mortar, crushed together to the extent of 95 per cent.; and the remaining 5 per cent. consisted of vegetable matter (probably partially decomposed saw-dust) and genuine guano. This mixture had been moistened with putrid urine, and re-dried. It certainly had the appearance of a fair sample of guano when casually looked at, and would no doubt deceive any person unaccustomed to the genuine article. When moistened with caustic potash, and heated, it only gave traces of ammonia compared with the effect produced on natural guano; and after drying and heating to a red heat, 95 per cent. of inorganic matter was left, which did not contain 1 per cent. of phosphates. An instance has occurred in which the adulterated matter prevailed to the extent of 97 per cent. At this rate, to obtain 4 cwt. of genuine guano (which is the usual quantity applied per acre), it would be necessary to purchase 6½ tons of the adulterated stuff, at a cost of about 66*l*. Umber is brought from Anglesey for the purpose of adulterating guano, in the proportion of about 15 cwt. of umber to 5 cwt. of guano. Stone is ground into a fine powder for the same purpose. Purchasers are also deluded by false analyses, and detection has hitherto been difficult.

Mr. Gyde has proposed that farmers' clubs should retain a respectable chemist at a salary, on the condition that he should perform analyses for the members of the club at a moderate fee. This would be better than judging of the quality of the guano by the strength of the ammoniacal odour, on which farmers sometimes rely; for the fact is, that the soundest guano has no smell of ammonia, and begins only to give out that smell when it is undergoing deterioration by decomposition. With local institutions resembling the Agricultural Chemistry Association of Scotland, the practice of adulteration would become hazardous, and possibly might not be attempted. The number of analyses of guano performed in the laboratory of the chemist of the Association in the first half of 1844, was 77. Purchases were made only after an analysis had been obtained from the sample most favourably reported on; and after the article had been delivered in bulk, a second analysis may be obtained as a further security. It is stated in the report of the Association, that of the 77 analyses of guano not one of them had been found spurious, and it is therefore a reasonable belief that the fear of exposure had deterred the dishonest dealers. In 1844 the number of analyses of guano samples was 134, and the Association reported at their annual meeting in January, 1845, that in only one case had a single instance occurred of adulterated guano in Scotland. This was a sample sent from London to an agent at Dumfries, from "one of the most respectable houses in the trade," and it contained 75 per cent. of chalk coloured by spent bark and ground to a fine powder.

With the knowledge supplied by an accurate analysis it is safe even to purchase adulterated guano, but of course at its proper value. Every cargo of saltpetre formerly sold by the East India Company was previously analysed at the India House, and the per centage of salt which each parcel contained was marked upon it. Thus, suppose the saltpetre contained 10 per cent.

of salt, the purchaser of 100 cwt. only paid for 90 cwt. of saltpetre. A general certificate or analysis of a cargo is not sufficient in the case of guano, as it gets into the hands of second-hand dealers, by whom, if genuine at first, it may be adulterated. Those who buy of the importer are not always secure. Dr. Ure's advice is, that "the farmer should never purchase guano, except its composition be warranted by the analysis of a competent chemist. He should cork up in a bottle a half-pound sample of each kind of guano that he buys; and if his crop should disappoint reasonable expectation, he should cause the samples to be analysed; and should the result not correspond to the analysis exhibited at the sale, he is fairly entitled to damages for the loss of his labour, rent, crop, &c." Dr. Ure analysed a cargo which was found to have nearly lost all its efficacious qualities, as it contained altogether only 2½ per cent. of ammonia, ½ per cent. of urate of ammonia, nearly 9 of sea-salt, 24 of water, and 45½ of earthy phosphates. Now a large cargo of this guano fetched a high price at a public sale under the exhibition of the following analysis :—

Urate of ammonia, ammoniacal salts, and decayed animal matter	18·4
Phosphate of lime, phosphate of magnesia, and oxalate of lime .	48·1
Fixed alkaline salts	10·8
Earthy and stony matter . . .	1·4
Moisture	22·3
	100

It is important also that African should not be substituted for Peruvian and Bolivian guanos. Dr. Ure says :—"Genuine Peruvian and Bolivian guanos surpass very far all other species of manure in the quantity of potential ammonia, and therefore in the permanency of their action on the roots of plants; while, in consequence of the ample store of actual ammonia they contain, they are qualified to give immediate vigour to vegetation. Urate of ammonia constitutes a considerable portion of the azotised organic matter in well preserved guano. It is nearly insoluble in water, not at all volatile, and is capable of yielding to the soil, by its gradual decomposition, nearly one-third of its weight of ammonia."—(Dr. Ure, *Journ. of the Royal Agricul. Soc. of England.*)

The difference between the African and Peruvian guano has been ably pointed out by a writer in the 'Chemical Gazette,' who states that these differences arise chiefly from the African guano being more exposed to the decomposing influences of the atmosphere and water than that which is found in South America. Several foreign chemists have expressed the opinion that the Peruvian guano is in a state of fossilization. The constituents which most strongly mark the two descriptions of guano are, the greater proportion of soluble matter which prevails in African guano. The Peruvian guano is most remarkable for having a larger proportion of uric acid, an element which dissolves very slowly. It follows that genuine African guano may act with greater rapidity than Peruvian, and that the influence of Peruvian will probably be felt for a longer period.

The value of guano may be estimated according to the proportions which it contains of—1. ammonia; 2. phosphates; 3. organic matter. Dr. Ure quotes African as varying in composition as follows :—

Moisture . .	from 21	to 36	per cent.
Ammonia . .	„ 5	„ 10	„
Organic matter	„ 35	„ 50	„
Phosphate of lime	„ 23	„ 35	„
Phosphate of magnesia & ammonia	„ 3	„ 6	„
Alkaline salts .	„ 1·5	„ 5	„
Sand, &c. . .	„ 1	„ 2	„

Mr. Lawes, another chemist, has collected the results of a number of analyses of Peruvian and African guano, and their composition varied as follows :—

	Peruvian.	African.
Water	12 to 15	25 to 30
Organic matter . .	50 „ 60	25 „ 30
Containing .	12 to 15 pts. of ammo.	5 to 9 pts. of ammo.
Phosphate of lime .	15 „ 25	25 „ 30
Fixed salts . . .	—	8 „ 10

In 1844 the council of the Royal Agricultural Society of England directed experiments to be made on the comparative merits of Peruvian and African guano as fertilizers, applied in equal quantities and under the same circumstances.

The moisture in guano is without value, so that a sample which gives 36 per cent. of moisture, can contain only 64 per cent. solid guano, and the value of this portion must be determined by analysis. A sample of African guano without any heterogeneous impurities, which Dr. Ure analysed, was of the specific gravity of 1·57 to water 1·00. Impure and decayed guano is denser, being sometimes of the specific gravity of 1·80 and 1·90. The best African guano, according to Dr. Ure, consisted of the following constituents:—

Saline and organic matter, containing 10 parts of pure ammonia	50·0
Water	21·5
Phosphate of lime and magnesia, as also potash	26·0
Silica	1·0
Sulphate and muriate of potash .	1·5
	100·

The following four analyses of African guano are by eminent chemists:—

1. By Mr. R. Phillips, of London.

Ammoniacal salts, containing 7⅕ of ammo. and organic animal matter	46·0
Phosphate of lime, &c.	19·8
Fixed alkaline salts	4·2
Sand	4·0
Water	26·0
	100·

2. By Mr. Herapath, of Bristol.

Phosphate of lime	21·
Soluble phosphate, with a little common salt	8·
The elements of ammonia . . .	11·
Other matter, almost entirely organic	60·
	100·

3. By Mr. Huson, of Liverpool.

Moisture (water)	16·5
Free ammonia	6·5
Ammoniacal salts, chiefly urate and phosphate of ammonia . . .	52·0
Carbonate of lime	6·0
Organic (animal) matter, with phosphate of lime, traces of oxide of iron, and an inappreciable amount of silica	19·0
	100·

4. From the 'Chemist,' by Watt.

Ammonia, partly in the state of carbonate	10·0
Bone phosphate of lime, including a portion of oxalate of lime . .	24·0
Uric or lithic acid	4·0
Alkaline, consisting principally of chloride of sodium	3·5
Phosphoric acid	4·0
Moisture, including a small portion of organic matter	24·0
Traces of silica, iron, &c.	0·5
Other organic matter, &c. . . .	30·0
	100·

Artificial guano may, of course, be compounded by an admixture of the constituents of natural guano. Professor Johnstone gives the following recipe for a fertilizer, which will produce an effect approximating in a considerable degree to the application of 1 cwt. of natural guano.

78¾	lbs.	bone-dust.
25	„	sulphate of ammonia.
1¼	„	pearl-ash.
25	„	common salt.
2½	„	dry sulphate of soda.
132½		

With the exception of bone-dust, all the above ingredients may be procured at almost any druggist's, and the whole will cost about 9*s.*

The following artificial substitute for guano has been used with considerable success, at the rate of 5 cwt. per acre, by Mr. Fleming, of Barochan, in Scotland:

		lbs.
Bones, dissolved in spirits of salt instead of oil of vitriol . . .		18¾
Charcoal powder	about	18¾
Sulphate of ammonia (gas salt)	about	9½
Common salt	about	9½
Gypsum		9½
Wood ashes	about	46
Nitrate of soda (cubic petre) . .		28
Sulphate of soda (Glauber salts) .		10
Sulphate of magnesia (Epsom salts)		10
		158

Potter's guano has a high reputation as an artificial fertilizing agent. In some experiments by the Earl of Zetland's agent on grass land, its effect was superior to that of Peruvian guano. By the time that the guano deposits of South America and Africa are exhausted, there can be little doubt that, with the aid of chemical science, artificial guanos will be compounded so perfect in their composition as to be little, if at all, inferior to natural guano.

The following are some of the other fertilizers and substances used in the preparation of hand-tillages:

Nitrate of Soda consists of nitric acid and soda, and is a natural product imported from Peru. Application: 1½ cwt. per acre, sown broadcast with its own weight of ashes or mould, for wheat, oats, grasses, &c. Weighs 80 lbs. per bushel; price per ton, 16*s.* 6*d.* Nitrate of soda is often adulterated with crushed Glauber and other cheap salts.

Nitrate of Potash consists of nitric acid and potass, and is a natural product imported from the East Indies. Application: 1 cwt. per acre, sown broadcast, in the same way as nitrate of soda, for wheat only. Weight per bushel, 80 lbs.; price of 1 cwt., 26*s.*

Petre Salt is the residuum of a manufacture, common salt and nitrate of potass. Application: 5 cwt. per acre, sown broadcast, for grass land. Weight per bushel, 75 lbs.; price of one ton, 4*l.* 10*s.*

Gypsum, sulphate of lime.—This is a product of sulphuric acid and lime. From 2½ to 3 cwt. per acre are sown broadcast on clover, trefoil, cinquefoin, and other grasses; and it is also used in compost heaps, and in stables and urine tanks. Weight from 80 to 84 lbs. per bushel; and the price of one ton is 32*s.* 6*d.*

Sulphate of Ammonia.—The residuum of a manufacture, sulphuric acid and ammonia. It is sown broadcast, in the proportion of 2 cwt. per acre, mixed with gypsum or mould, and is applied for clover, oats, &c.

Bone-dust and Half-inch Bones contain phosphates of lime and magnesia, carbonate of lime and animal matter, yielding ammonia. Weight per bushel, 42 to 45 lbs.; price per quarter, 20*s.*

Calcined Bones.—The same constituents as bone-dust, with the exception of the animal matter. It is useful for mixing with farm-yard dung and other manures containing ammonia. Price per cwt., 8*s.* to 10*s.*

Phosphate of Lime—a preparation consisting of phosphoric acid and lime, which is more easily mixed with farm-yard manure than lime. Price per cwt., 7*s.*

Superphosphate of Lime consists of phosphoric acid and lime in a more soluble state than in bones; and is prepared by dissolving bones in sulphuric acid. The superphosphate is used for mixing in composts, fixing the ammonia of dung-heaps and urine tanks with formation of phosphate of ammonia; and for turnips, in the proportion of 3 or 4 cwt. per acre. Price per cwt., 8*s.*

Phosphate of Ammonia is composed of phosphoric acid and ammonia, and is used for mixing in compost for the purpose of imparting these two important constituents of plants. Price per cwt., 24*s.*; or in fine powder, 28*s.*

Muriate of Ammonia is used in the same way as the phosphate for imparting muriatic acid and ammonia. Weight per bushel, 65 to 70 lbs.; price per cwt., 20*s.* to 24*s.*

Muriate of Lime, that is, muriatic acid and lime. Used for mixing with compost heaps. Weight per bushel, 65 to 70 lbs.; price of 4 cwt. in a cask, 24*s.*

Sulphate of Magnesia (sulphuric acid and magnesia). Recommended for mixing with night-soil for potatoes, and at the rate of 1 cwt. per acre to eight loads of stable-dung. Price per cwt., pure crystals, 10*s.* to 12*s.*; impure, 8*s.* to 9*s.*

Sulphate of Soda (sulphuric acid and soda). Applied in the proportion of 1 cwt. to 1 cwt. of sulphate of magnesia and 28 lbs. nitrate of soda. Price per cwt., pure crystals, 6*s.*; impure, 5*s.*

Sulphuric Acid (oil of vitriol).—For fixing ammonia in urine-tanks and manure heaps; also for decomposing bones and for forming superphosphate of lime. The manner in which sulphuric acid is employed in the formation of superphosphate of lime, has already been described. The price of sulphuric acid varies from 1*d.* to 1½*d.* per lb., according to the quantity taken. The following simple directions for using the sulphuric acid in dissolving bones, are by Mr. Lawes, of St. Albans:—“ Calcined bones are to be reduced by grinding to a very fine powder, and placed in an iron pan with an equal weight of water (a cast-iron trough, such as are sold for holding water for cattle, will do); a man with a spade must mix the bone with the water until every portion is wet. While the man is stirring, an assistant empties at once into the pan sulphuric acid, 60 parts in weight to every 100 parts of bone; the acid is poured in at once, and not in a thin stream as commonly recommended; the stirring is continued for about three minutes, and the material is then thrown out. With four common farm-labourers and two pans, I have mixed two tons in one day. The larger the heap that is made the more perfect the decomposition, as the heat remains intensely hot for a long time. It is necessary to spread the superphosphate out to the air for a few days, that it may become dry.”—(Journ. of Royal Agric. Soc., part ii. vol. v. 1845. This number also contains details of several experiments with bones and sulphuric acid as manure.)

The value of 4 cwts. of guano, which is the usual dressing for an acre, is usually understood to be equal to 15 tons of farm-yard dung. The constituents of these two quantities are given in the following table by Mr. Lawes: —

Guano.	lbs.
Phosphate of lime	112
Ammonia	54
Organic matter	171
Potash, soda	30

Dung.	
Phosphate of lime	100
Ammonia	195
Organic matter	8505
Potash, soda, and silica	1335

An analysis of two samples of turnips, raised respectively by means of dung and guano, was lately made for the Agricultural Chemistry Association of Scotland, and were found to present remarkable differences in their chemical constituents. An experiment was next made of their feeding qualities; and the result was, that the cattle which fed on the dung turnips throve by far the most rapidly. It is obvious, however, that nothing can be determined by this single trial; and it is satisfactory to learn that it is to be repeated.

Various questions involved in the extensive use of artificial hand-tillages of recent introduction, can only be determined after they have been applied for a length of time, by a great number of persons, and under every variety of circumstances. That experiments with them should be made cautiously cannot be doubted; for though their efficacy in many instances cannot be disputed, their general action is only to be learned by experience. The following very important considerations by Mr. Barton, of East Leigh, Emsworth, are not the less valuable because they are calculated to inspire the practical farmer with caution, which, in the end, will be more advantageous to the progress of scientific agriculture than misplaced confidence. “ In estimating,” says Mr. Barton, “ the value of manures, we are apt to confine our attention too much to the immediate results. Manures differ exceedingly as to the condition in which they leave the land in the year following the first crop. Of stable-dung it is estimated that one-half is left in the land after a crop of wheat. As to some other manures (lime, for instance), it seems to be now admitted by the most accurate observers, that they ultimately exhaust the soil, though they produce an immediate benefit. In fact, manures of this class act as *stimulants* merely; they bring into an active and soluble form the humus previously existing in the soil, but add nothing to the store of nutritive matter. Instead of leaving the land in better condition, they actually deteriorate it. That deterioration may, indeed, be compensated, or even more than compensated, by the immediate profit; the farmer may gain such an immense crop as, if laid out in the purchase of manure, may place him and his land, on the whole, in a better position than if the stimulating manure had not been applied. But it must always be a most important question, in what *way* does any given application tend to increase the produce of the soil? And when I see comparative statements of the crops yielded by different manures, without any notice of the tendency of such manures to benefit or injure the soil in succeeding years, I cannot but fear that they tend to mislead many readers. With regard to guano, looking at its reported origin and its chemical composition, one can scarcely doubt that it enriches the soil; but its very caustic quality may raise a question whether a part of its beneficial effect does not arise from its stimulating properties. If so, its value cannot surely be truly estimated by comparing the increase of crop yielded by guano and by yard-dung. How might this question be brought to test? Might it not be done by dressing a piece of land heavily, year by year, with guano or other of these new manures, applying no dung to it, and cropping it in the usual manner? If the manure under trial operates as a stimulus merely, the land would be found, under this management, to grow progressively poorer every crop: if, on the contrary, it operates as nutriment, the land would grow progressively richer."

Directions for applying Guano.—In adopting the directions prepared for the use of Sir Charles Lemon's tenantry, we have added some further suggestions, calculated to be of practical utility to those who have not as yet made use of guano.

1. "It should never be applied in contact with seeds, as it kills them immediately they begin to vegetate."

2. "It should be mixed as equally as possible with about four times its bulk of finely pulverized earth, burnt clay, turf, or peat ashes, after they have become cold: if sand is used, about twice the quantity of guano will be sufficient." The object of mixing guano with other substances is to regulate its action. In a cold soil the admixture of ashes, &c. should be less than for a warm light soil; and the earlier the season in which the guano is applied the smaller proportion is required of the matter to be mixed with it. When dung, bones, rape-dust, or other fertilizing matter is applied along with guano, the quantity of the latter should be diminished. As the ashes of most vegetable substances contain alkaline salts, and as these, when mixed with neutral salts of ammonia, decompose them and set free the ammonia, they should not be used; but the ashes of mineral coal do not act in this way and may therefore be used. Lime and guano should not be used in contact; and in fact, after a dressing of lime has been applied to the land, guano should not be used until several weeks have elapsed, as the lime acts too rapidly on guano. Bones and guano used together act in the same way.

3. "The quantity of guano per acre may vary from two to four cwt., according to the nature and quality of the soil." It is stated in the Proceedings of the Horticultural Society, No. 17, 1843, that in loam containing about one-fiftieth part of guano, verbenas and salvias become luxuriant in about the same degree as if potted in rotten dung. The same plants also flourished luxuriantly in sand which contained a similar proportion of guano. Its action was still more beneficial when peat was substituted for sand, but when rich garden soil was employed with the same proportion of guano the plants became languid and died. Experience alone can determine whether guano should be applied broadcast, harrowed in, and the seed sown upon it, or whether it should be drilled in with the seed mixed of course with ashes, burnt-clay, or some other similar material. Mr. Milburn (Yorkshire Prize Essay on Guano) states, that it "appears to be more useful broadcast than sown by drill;" "more adapted for strong lands than light."

4. "The best time for applying guano is shortly after vegetation has commenced, or immediately before rain, or during damp, warm weather." Guano rapidly absorbs moisture from the air, and the better the quality of the guano the greater is its action as an absorbent. Two specimens of guano of different quality were dried at 150°, and the worst specimen lost 15 per cent. between water and ammonia, and the best $22\frac{1}{2}$ per cent. On these specimens being exposed to the night air at 35°, the worst recovered nearly 6 per cent. of moisture, and the best rather more than $8\frac{1}{2}$. Guano has frequently proved a failure when its application has not been followed by rain, and a wet season is generally considered most favourable to its success.

5. "The best mode of application is, to divide the quantity of guano to be used per acre into two or three equal portions, and sow them at intervals of about ten days or a fortnight." The best period for applying these instalments has not been fully ascertained.

6. "For small allotments it may be more convenient to use guano in a liquid state, in which case mix 4 lbs. of guano with twelve gallons of water, and let it stand for twelve hours before being used." From ½ cwt. to 1 cwt. of guano may be used to 160 gallons of water per acre. The undissolved parts of the guano form a good compost.

Experiments with guano and other fertilizers.—Reference should be made to the works mentioned at the end of this notice, for complete details of the numerous experiments which have been made, not only with guano, but other fertilizers of recent introduction. Those in which it has been tried in comparison with farm-yard manure are especially interesting. Some experiments instituted by the Royal Agricultural Society gave the following results:—1. The Rev. T. Cator, of Skelbrooke Park, near Doncaster, found 300 lbs. of guano per acre to a crop of potatoes, applied when they were ready for earthing, produced an effect equal to 18 loads of farm-yard manure used in the usual way. 2. In 1843, a crop of beans was manured with guano, pigeon's dung, rape-dust, and farm-yard manure; and though solitary experiments prove little or nothing, it may be stated that in the following season the wheat-crop came up best on that part of the land to which guano had been applied. 3. Mr. Davenport, of Capesthorne, Cheshire, found 3 cwt. of good Peruvian guano equal to twenty tons of good farm-yard manure. These solitary experiments are better than none at all, and as they will satisfy no one, they are calculated to lead to more extensive experiments.

Turnips.—The use of guano to this important crop is beneficial, not only in increasing the amount of produce, but by stimulating the rapid vegetation of the plant, it places it sooner out of the reach of the ravages of the fly. Mr. Grey, of Dilston, Cumberland, remarks:—"From my experience of guano, I have come to this conclusion, that it is very valuable as a stimulant to green crops, where rapid growth and rapid consumption are the sole objects,—as with rape and tares. That it is also valuable in bringing turnips quickly to the hoe, and placing them beyond the ravages of the fly, which is very important; but that it gives off its ammonia too quickly to continue to promote their growth throughout the whole of the time in which turnips are known to increase, in favourable autumns, or on other kinds of manure; on which account, I should recommend to apply half the usual quantity of dung or bones, in the hollow of the drill-ridge, covering it by a light furrow from one side, and upon that to lay half a dose, say 1½ cwt. of guano, turning upon it a furrow from the other side, so as to complete the ridge upon which to sow the seed by drill. This mode ensures to the crop the early stimulus of guano, and also the more permanent effects of other manures. I have known a crop of turnips produce 4 tons more where 10 single-horse carts of dung and 1½ cwt. of guano were so applied, than was produced in the same field, and on each side of it, by the application of twenty cart loads of dung, and 3 cwt. of guano per acre, separately. The circumstance of its speedy action, and consequently early exhaustion, renders guano an unsafe manure by itself, for wheat and other crops of slow growth, which require the nourishment to be sustained for many months."—(Milburn's *Prize Essay on Guano.*) The superphosphate of lime will probably be found still better calculated to produce a rapid growth of the turnip plant in its early stages.

On a light dry soil in Galloway, with a sandy, gravelly subsoil, guano, carbon, dung, and bones, were used separately for Swedish turnips in the following proportions, and with the result mentioned below:—

	Produce.	
Per Scotch Acre.	Tons.	cwts.
Dung, 60 cart-loads (40 yds.)	15	10½
Guano, 4 cwt.	17	4½
Carbon, 1½ tons	15	19½
Bones, 30 bushels	15	"

The seed sown with guano came up first, and was fit for singling three days sooner than the rest. That sown with bones came up three days later than the rest, and was six days after the guano. In an experiment by Sir John Tylden with Lawes's superphosphate of lime, Potter's guano, Peruvian and African guano, the superphosphate was found to have accelerated vegetation more than either of the other manures. The plants which grew on the land where it had been applied were ready for the hoe a week at least before the Peruvian, ten days before the African, and three weeks earlier than Potter's, and the expense was nearly 1*l.* an acre less.

In Berwickshire, on a light soil, hazel colour, with a sandy subsoil, white globe turnips were sown after oats, and the result of using different proportions of guano, or guano in combination with other manures, was as follows :—

Manure per Acre.	Produce. Tons.	cwts.
1. Guano, 1 cwt., and dung, 10 tons	21	16
2. Guano, 1¼ cwt., and bones, 1 quarter	22	,,
3. Guano, 2½ cwt.	23	14
4. Damaged oil-cake, 2 qrs. .	23	,,
5. Bones, 2 qrs.	19	6
6. Bones, 1 qr., and dung, 10 tons	20	,,

Potatoes.—For this root the drills are opened, the guano sown in the furrows, and it is then mixed with the soil by the horse-hoe, and the sets are planted above it, taking care that they do not come in contact with the guano. Some experiments, conducted by Mr. Fleming, of Barochan, in Scotland, and communicated by Professor Johnston, show that 3 cwt. of guano an acre, put in with the sets, and not subsequently top-dressed, produced a crop of 18½ tons, the produce from unmanured land being only 6¾ tons. Some further experiments with other fertilizers on the same land gave the following results :—

	Cwts.	Produce per Acre. Tons.	cwts.
1. Sulph. of Magnesia . Nitrate of soda . .	1 1	22	10
2. Sulph. of soda . . Sulph. of ammonia .	1¼ ¾	18	17
3. Nitrate of potash .	1½	18	10
4. Sulph. of soda . . Nitrate of soda . .	1¼ ¾	18	0
5. Nitrate of soda . .	1½	16	0
6. Sulph. of ammonia .	1½	14	10
7. Sulph. of magnesia .	1½	13	5
8. Sulph. of soda . .	2	12	15
9. Farm-yard manure, 40 cubic yards . . .		12	15

In the above table it will be seen that the best crop was produced by a combination of sulphate of magnesia and nitrate of soda, while these two ingredients were much less efficacious when applied separately. Professor Johnston remarks that potatoes grown by means of nitrate and sulphate of soda in 1842, were used with manifest superiority for sets in the following season; and that they produced a heavier crop by 3¾ tons per acre than other potatoes to which the above fertilizers had not been applied.

The following results of experiments made in Ireland are given in Mr. Milburn's 'Essay.' The land was a moderately tenacious clay of superior quality, which had been many years in grass; and before the potatoes had put forth shoots, the following manures were spread on the surface, and the ridges were then covered with two inches of soil. The produce was as under :—

			Tons.	cwts.
Guano	cwt.	3	19	11
Bone-dust . .	bushels	18	15	13
Nitrate of soda	,,	2	16	19
Nitrate of potash . . .	,,	2	15	5
Muriate of ammonia . .	,,	2	17	15
Equal quantities of sea & quick lime . .	,,	8	14	17
Farm-yard manure . . .	tons	10	16	3
No manure			13	10

In each case the increase of crop repaid the outlay for manure. Mr. Milburn states that Mr. Templeton, of Ballyleidy, Ireland, found that 5 cwt. of guano were equal to 40 tons of farm-yard manure. This might be the case, looking only to the results of one year; but in what state would the land be found in succeeding years?

Wheat.—We give the result of an experiment, in which guano and other manures were tried for this important crop. The experiment was upon a clover-ley wheat at Kingsdown, Kent. Farm-yard manure was ploughed in at the time of sowing, about 22nd of Nov., 1843; and the guano and other manures were used as a top-dressing, March 19th, 1844.

No.	Manure.	Quantity per Acre.	Cost.
1.	Farm-yard dung	30 cart-loads	£4 10 0
2.	Peruvian guano	3 cwts. 2 qrs. 18 lbs.	2 4 0
3.	Rape-dust	5 cwts.	1 12 6
4.	Urate	6 cwts. 2 qrs.	1 12 6
5.	Superphosphate of lime	6 cwts. 1 qr. 4 lbs	2 4 9
6.	No dressing	..	..

RESULTS.

No.	Produce. Bush.	gals.	Straw. lbs.	Weight, per Bushel. lbs.	Increase. Bush.	gals.
1.	40	6	2,376	62½	11	4
2.	40	6	2,196	62	11	4
3.	38	3	1,872	61	9	1
4.	38	5	2,028	60	9	3
5.	53	5	2,940	61	24	3
6.	29	2	1,472	61	0	0

(Journ. of Royal Agric. Soc., Part ii. vol. v., 1845.)

Grass, Clover, Seeds.—There are details of experiments, in which guano has been very successfully applied to meadows, clover, lucerne, seeds, &c., but it has not invariably succeeded. The guano-dealers, on the contrary, say that grass, of all other crops, is most benefited by this manure. Lord Zetland did not find it answer. The produce was only one-twelfth more than on that portion of the land where no manure had been applied, and did not repay the extra cost. Mr. Campbell, of the Botanic Gardens, Manchester, made a series of careful experiments on a lawn with guano, applied at the rate of from 2¾ cwt. to 21 cwt. per imperial acre. The results are given in Clarke's 'Guano as a Manure.' See also Milburn's 'Prize Essay.'

In 1841 the Highland and Agricultural Society of Scotland offered prizes for the best Essays 'On the Effects of Special Manures;' and the first and second prizes were awarded to Mr. John Hannam and Mr. Gardiner, whose Essays, containing details of experiments and their results, are published in the Society's 'Transactions.' Mr. Gardiner's conclusions as to the effect of the substances used are as follows:*—

"1st. That all dressings and manures containing a large per centage of nitrogen, as guano, rape-dust, salts of ammonia, nitrates of soda, &c., make the grain grown by them lighter in weight per bushel, while at the same time they give more bushels per acre, as well as more straw.

"2nd. That, on the other hand, such manures as common salt give heavier grain per bushel, but fewer bushels per acre.

"3rd. That if the same be found to hold good in other places, the most judicious and economical method is to use a mixture of these, as common salt with nitrate of soda, or any of the others; the one will give *quantity*, while the other will give *weight*.

"4th. That guano does not lessen the weight of grain quite so much as the nitrates of soda and potash, and that a mixture of it with salt would, there is reason to believe, become one of the best dressings for wheat crops.

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* Gardeners' Chron. and Agric. Gazette, May 3rd, 1845.

"5th. That salt will, in places far from the sea, in general be found advantageous as a dressing upon grain crops; although it does not bring away a rush of growth like the nitrates, it will be found in such places that it will cause the grain to weigh more, and be of better quality in clearness of colour and plumpness.

"6th. That the sulphates and muriates of ammonia act in the same way, and have the same effect as the nitrates of soda and potash.

"7th. That sulphates of soda and magnesia act differently, and in many cases will not pay when applied to grain by themselves.

"8th. That soot differs little in its effects from the nitrates; but that upon grain its effects are more evanescent.

"9th. That guano is 'a universal manure,' and 'has in all cases been found an acquisition.'"

It would scarcely have been satisfactory to have extended the list of experiments, for the details, which would occupy too much space, are what the practical farmer desires to know; and for these he must refer to the 'Journal of the Royal Agricultural Society of England,' 'Journal of the Highland and Agricultural Society,' the 'Gardeners' Chronicle and Agricultural Gazette,' edited by Dr. Lindley; and various recent works on agriculture. There are a number of pamphlets published by importers or dealers in manures, which will afford useful information; but their statements must be acted upon cautiously, as only those results which are favourable are published. The Journals of the 'Royal Agricultural Society' and the 'Highland and Agricultural Society' and the 'Gardeners' Chronicle' are in every respect deserving of confidence.

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